the OIL AND GAS JOURNAL
PUBLISHED WEEKLY MARCH 20, 1961

NATURAL-GAS PROCESSING

. . . a special issue featuring the Journal's annual survey of gas-processing plants in the U. S. and Canada, and selected NGAA papers.

. . . plus an article on the growing importance of helium to the gas processor and an article on the newest big helium plant.

p. 89

1960: Capacity: up 5 billion feet
Liquid output: up 8 per cent

1961: Another big jump for both

p. 63

AAPG study shows:

Exploratory drilling off 11.2 % in 1960

p. 66

Industry may have cash surplus for next 3 years

p. 70

ANNOUNCING A NEW REFINERY FOR AUSTRALIA

Engineering, Procurement, Construction Assigned by Stanvac to Kellogg

*Standard-Vacuum Oil Company release, February 21, 1961**

WHITE PLAINS, N.Y.—The contract for Standard-Vacuum Oil Company's second refinery in Australia—a 37,800 barrels-a-day fuel products and solvents plant to be built near Adelaide, South Australia—has been awarded to The M.W. Kellogg Company. The award was announced yesterday in Adelaide by Sir Thomas Playford, Premier of South Australia, on behalf of Stanvac's affiliate, Standard-Vacuum Refining Company (Australia) Pty. Ltd.

The refinery will be constructed on a 594-acre site at Port Noarlunga, 14 miles south of the South Australian capital city. Ground will be broken in mid-year, and start-up is scheduled for January 1963.

The new plant will raise Stanvac's crude processing capacity in Australia to approximately 80,000 barrels a day.

Plans call for the use of Persian Gulf crude oil for the production of gasoline, diesel fuels, illuminating kerosene, liquefied petroleum gas, sulfur, asphalt, and solvents—all for the Australian market.

Kellogg's contract covers engineering, requisitioning, and procurement, as well as construction of all process and mechanical equipment, tankage, buildings, and utilities. Major process units will be a crude splitter, vacuum pipestill, hydro-desulfurizer, catalytic reformer and sulfur recovery plant. Tankage will be installed for nearly 2.5 million barrels of crude oil and products.

Maximum use during the construction period will be made of Australian labor, sub-contractors, and suppliers.

Stanvac's entry into petroleum refining in Australia was in 1948, when it built a small lubricating oil plant. This was expanded in 1953 for the production of fuel products. It currently has a throughput capacity of 42,000 barrels a day.

THE M. W. KELLOGG COMPANY

711 Third Avenue, New York 17, N.Y. • A Subsidiary of Pullman Incorporated

Offices of other Kellogg companies are in Toronto, London, Paris, Rio de Janeiro, Caracas, Buenos Aires

*Even before this date, The M. W. Kellogg Company in New York, and its subsidiary constructing the plant in Australia, were at work on the project.

OIL AND GAS JOURNAL
Vol. 59, No. 12

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ANNUAL GAS PROCESSING REPORT

Molecular Sieves Sweeten Natural Gasoline 89

By Kenneth H. Bacon and Alfred M. Henke

Natural gasoline can be desulfurized and sweetened by cyclic adsorption and regeneration using 13X molecular sieves. Sulfur content can be reduced to meet rather stringent specifications. Preliminary results indicate the process is noncorrosive and commercially feasible.

What Sun Has Learned About Gas Turbine in Gas Processing 93

By B. L. Short

Gas turbines and the turbine-heater installation of Sun Oil Co. in its Laverne gas-products plant have proved to be very reliable during 20 months of operation. While there have been a few problems connected with the shakedown period, the turbine section of the plant has given less trouble than some of the other parts of the plant using "standard" equipment.

Will We Continue to Have an Adequate Supply of Helium? 96

By Paul V. Mullins

Helium consumption has increased nearly tenfold in the past 12 years, and principal resources of this gas are contained in natural-gas reservoirs that will be dissipated at a fairly rapid rate. A broad helium-conservation program is being proposed to guarantee the nation an adequate supply of helium for the future.

Keyes Plant Makes Helium for $9.11 per M.c.f. 101

By W. M. Deaton and R. D. Haynes

The $11,000,000 Keyes helium plant processes 2% helium-bearing natural gas to produce 290 M.M.c.f. of product annually. A low-temperature process involving two steps is used. The first separates the crude-helium product from natural gas; the second purifies the crude material to a high-purity product.

Annual Survey of Gas-Processing Plants in the U. S. 106

By Hugh S. Pylant and R. B. Bizal

A new survey of more than 630 existing plants in the U. S. shows total capacity has climbed to more than 40,520 M.M.c.f. daily. The survey includes a plant-by-plant breakdown of throughputs, daily production of various liquids, and process methods. Total production has risen to more than 43,468,000 gal. per day. Cycling operations are indicated with a star symbol.

Annual Survey of Gas-Processing Plants in Canada 133

This plant-by-plant table of existing facilities in Canada gives total capacity for 50 plants at more than 3,117 M.M.c.f. daily. Liquids recovery is reported at more than 1,311,000 gal. daily.

New Gas-Processing Facilities to Jump Capacity 137

The Journal's latest construction report shows 53 new projects recently completed, under way, or planned. These will add another 3,890 M.M.c.f. daily capacity in the U. S. and Canada. The new projects include 43 in the U. S. and 10 in Canada.

TECHNOLOGY—OPERATION

Oil-Well Pumping—36 142

By Joseph Zaba

WPRA Panel Answers Questions on Cracking Catalysts 144

How to Reduce Drilling Costs—Part 10 152

By Preston L. Moore

How pH Controls Contaminated Flood Waters 156

By George C. Bernard and Henry L. Chamberlain

Regular Maintenance Checks Pay Off For Pipeline 158

the OIL AND GAS JOURNAL Newsletter

Tulsa, Okla.
March 20, 1961

It will take a miracle to keep gasoline stocks from hitting an all-time high in the next few days.

Latest report shows increase of 3,561,000 bbl. to 224,653,000. That's getting awfully close to the record of 225,987,000 bbl. set last year on March 26.

Refinery runs for week ending March 10 averaged 8,264,000 bbl. daily, 210,000 bbl. daily below previous week but still 482,000 bbl. higher than the corresponding week a year ago.

For the past 4 weeks, runs have averaged 8,390,000 bbl. daily compared with 7,973,000 bbl. daily in similar period of 1960.

There'll be a new end-of-season record in distillate stocks.

Record for distillate stocks at end of March now stands at 80,662,000 bbl. On March 10 stocks still topped 95,000,000 bbl., and there's no chance of a 15,000,000-bbl. reduction by the close of this month.

Rotary rig activity is showing good seasonal increase.

Total of 1,603 rigs at work last week contrasts favorably with 1,560 of week before. This was first time since early January that total went over 1,600.

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New survey shows rush of growth in gas-processing industry.

Boom's evident in figures. Eighty new plants or expansion programs got started in 1960, and 45 are under way this year. Capacity shot from 35.52 billion cubic feet of gas daily last year to current 40.52 billion. Additional 7% gain is expected in 1961.

Forecast: Mushrooming will continue well into next year (p. 63 and p. 137).

Natural-gas stocks continue to be popular with investors.

American Gas Association reports prices pushed to third straight record level last month, reaching $57.18 a share. This represents 23% rise from year ago.

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Exploratory drilling last year declined 11.2% and percentage of successes was at 12-year low.

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*Refers to article in this issue giving more details. When no page is given, the item is a Newsletter exclusive.

Poor showing's revealed in statistics released by American Association of Petroleum Geologists (p. 66).

Oklahoma's deep-production record has been broken by wildcat in Anadarko basin. New title-holder, Gulf Oil's 1 Wood in Grady County, went to total depth of 17,000 ft. Production's at intervals from 16,180 to 16,376 ft.

This record may not stand long. Nine tests drilling or planned along trough of basin are scheduled to go to total depth of 1 Wood or beyond (p. 74).

Alabama's getting into ultra-deep drilling, too.

H. L. Hunt is drilling below 18,000 ft. in his 1 Tyler-Odem wildcat on Vinegar Bend prospect in southern Washington County. Depth is more than 2,270 ft. below previous mark of 15,729 ft.

Scoreboard on 6-month-old Arnold David field in Corpus Christi area of Texas Gulf Coast makes outlook there a glittering one.

Record: Thirty-two good oil wells, seven rotary rigs now working, new well every 10 or 12 days, no dry holes so far. Drilling conditions are nearly perfect in new field, which produces from prolific Frio formation (p. 78).

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It seems likely that producers will benefit from new study of crude-oil import controls being planned by Interior.

Deeply involved: Interior Secretary Stewart L. Udall, who is convinced of need for healthy domestic industry.

Result may be changes in current program, including tighter crude-import restrictions.

Expect federal gasoline-tax level to stay high. Heavy pressure is on to keep road-construction program moving, and administration wants to avoid tapping general revenues or falling back on deficit financing.

About all industry can hope for is a compromise—maybe tax of 3½ cents instead of 4 cents.

Word from Secretary Udall: Frederick S. Lott will be serving as acting director of Interior's Office of Oil and Gas for several months, at least.

Lott's been assistant director under Navy Capt. Matthew V. Carson, Jr., whose recent notice of resignation brought letter from Udall praising his work in highest terms.

If gas legislation becomes lively issue in Congress this year, impetus will come from administration rather than from the industry. Many segments will be unhappy over results.

Outlook: James M. Landis, adviser to President Kennedy on regulatory matters, is at work on proposals. These may include plan to speed up Federal Power Commission action by eliminating smaller pro-

ducers from control and using utility-type regulation on large producers.

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Look for drastic shortage of petroleum engineers in years ahead.

That's the word from Dr. Carl Gatlin, chairman of University of Texas' petroleum engineering department.

Number of graduates in field is shrinking fast. Gatlin reports total of bachelor's degrees in petroleum engineering throughout nation was cut in half between 1957 and 1960—down from 800 to 400.

Gatlin's reason for lack of student interest: Pessimism in industry over excess supplies of oil and gas. His opinion: Decline in number of graduates isn't justified on basis of future world demand for oil.

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Crude exports from Canada to U. S. Midwest are on the rise.

In first 2 months of 1961, exports were 15% ahead of total a year ago. March exports are higher still.

Two-month average this year was 83,048 bbl. daily against 70,653 bbl. daily for 1960. Estimate for March: 90,032 bbl. daily.

Russia expects to put on stream about 7.6 million tons, or 152,000 bbl. daily, of new refining capacity this year. Fifty per cent boost in output of higher octane also is planned. But added process capacity will be less than half the projected gain for crude production. This will allow record amount of crude for export.

Sharp cut in subsidy for oil imports has been ordered by Brazil's new president, Janio Quadros. Drastic move, designed to help curtail inflation, may double retail-products prices and put brake on imports. But in long run, it should help stabilize economy by ending need to print billions of extra cruzeiros to pay for oil.

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Industry notes: Some Shell stations in Ottawa and Montreal are testing "do-it-yourself" coin-operated vacuum cleaner. For 25 cents motorists can clean upholstery and carpeting while waiting for other servicing...Bid to double maximum size of billboards on interstate highway system is out, and 150-sq.-ft. limit set in 1958 remains in force. Commerce Secretary Luther Hodges rejected proposal after highway officials told him most comments they got on it were unfavorable...Larger share of Texaco's capital budget this year will be devoted to building terminals, products pipelines, and more modern service stations. Company's annual report also says capital and exploration spending will stay about same as 1960's $521 million...Personnel prospects as picked up at midwinter meeting of American Management Association: Big increases in unskilled or semiskilled workers, growing shortages of college-trained executives and engineers. Segments of greatest growth will be in over-45 and under-25 age brackets.

Market Memo

March 20, 1961

Threat of a price break on Gulf Coast No. 2 deepened last week until a slow, pessimistic countdown got under way—with betting on a one-fourth cent drop.

For several days, belief had been that anyone seeking No. 2 at from three-eighths to one-half cent off posted price of 9.5 cents could make a deal.

One of week's most interesting rumors: Large East Coast buyer offered to take No. 2 at 8.5 cents, a full cent off posted price.

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Two chronically depressed East Coast gasoline markets took opposite turns. New England displayed definite strength but deep cuts were made in the Carolinas.

Texaco sparked the New England advance, which drove prices up one-eighth cent a gallon in the area of Boston, one-ninth cent in Providence, and a full cent in Portland. Mobil, traditional leader in the market area, generally followed the Texaco pattern. Other suppliers made varying changes while waiting for developments.

Esso cut net dealer prices over most of the Carolinas to meet competition from private branders. Charlotte, N. C., took deepest slash of 1.7 cents, reducing price to 12.5 cents for regular.

East Coast heating suppliers are keeping their fingers crossed after a February that was 30% warmer than January.

Continued warm weather is inspiring further price discounts on distillates.

Buyers generally are holding back in anticipation of the seasonal price drop.

Mostly inactive last week: Mississippi River and Great Lakes Pipe Line. Recent colder weather has improved Chicago's situation.

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Around the marketing beat: Slump in sales of gasoline and other products at service stations in February is reported by Census Bureau. Drop brought sales for month to $1,225 million compared to $1,367 million in January. February sales year ago were $1,286 million...Natural gas is getting lion's share of business in new homes being built on Long Island, N. Y., scene of one of nation's biggest home-building booms. But National Fuel Oil Council says home owners with oil heat seem to be prouder of it all along the East Coast. Oil heat got four times as many mentions as gas in real-estate ads surveyed in cities from Boston to Charlotte, N. C. Coal or electric heat received no significant mention.

Good Wells Make Good News

A Report on Interesting Acidizing Treatments by Dowell

March 20, 1961

These four recent examples demonstrate a few of the many well conditions that respond to Dowell acidizing.

- **Alberta, Canada** (New Gas Well) When a drill stem test yielded 4 mmcfd, operator decided to complete this wildcat. Pay is the Mississippian lime between 6971 and 7013 feet. Porosity is 5.1 per cent. Solubility is 95.5 per cent. Average permeability of the interval is one millidarcy. There are short, more permeable sections at two levels within this interval. These permeable sections were perforated, washed with BDA* Breakdown Acid and acidized. 30,000 gallons of a special Retarded Acid, with a fluid loss additive, were injected using three Allison-powered pumpers. The Acid Guide* was used to plan this treatment. Production test before treatment was 100 mcfd. After treatment well tested 14.2 mmcfd at 1900 psi on ½-inch choke. (Calculated open flow was 35 mmcfd.)

- **Tom Green County, West Texas** (Abandoned Oil Well) This well in the Mertzon-San Angelo pool had originally been perforated and acidized. It was abandoned temporarily after producing only 3 barrels of oil and eight barrels of water per day. Recently, Dowell was called to help recomplete the well. First, the old perforations from 1550 to 1565 feet were squeezed off using 125 sacks of cement modified with FLAC* fluid loss additive for cement. Next, three holes were jetted at 1558 feet with Abrasijet* -- Dowell's abrasive jetting service. Then the well was acidized with 500 gallons regular acid. After clean-up, well tested 100 bopd; no water.

- **Texas County, Oklahoma** (New Gas Well) A lower section of the Topeka lime (3182 to 3198 feet) tested 3 mmcfd after being perforated and acidized. A plug was set above this section and an upper zone was then perforated from 3090 to 3160 feet. When it also tested 3 mmcfd, communication was suspected. Dowell suggested selective acidizing using rock salt as a temporary plugging material. The upper section was acidized with 15,000 gallons Dowell acid containing demulsifier, surfactant and a silicate control agent. 4000 pounds of rock salt were used in three stages during treatment to block communication with the lower zone and to divert acid into the less permeable sections of the upper zone. After well was swabbed and cleaned up, it tested 14.5 mmcfd from the two zones combined.

- **Lafourche Parish, South Louisiana** (Old Oil Well) This well in the Miocene was mudded off during workover and would not come in despite good porosity and permeability. Dowell acidized with 500 gallons Mud Acid injected between 250-gallon slugs of regular acid containing a demulsifier and an agent to lower surface tension. Injection rate was one bpm at 1700 psi. After acid was swabbed out, well made 115 bopd allowable.

Dowell services and products are offered from more than 150 offices and stations in the United States, Canada, Venezuela, Argentina, Germany, France and the Sahara area. Dowell, Tulsa 1, Oklahoma.

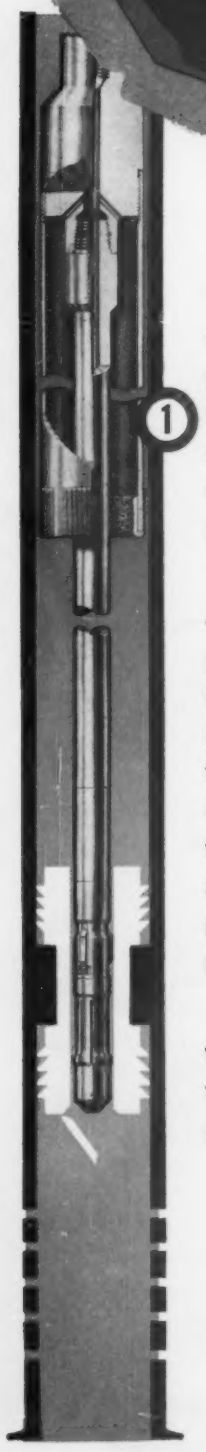
*DOWELL TRADEMARK

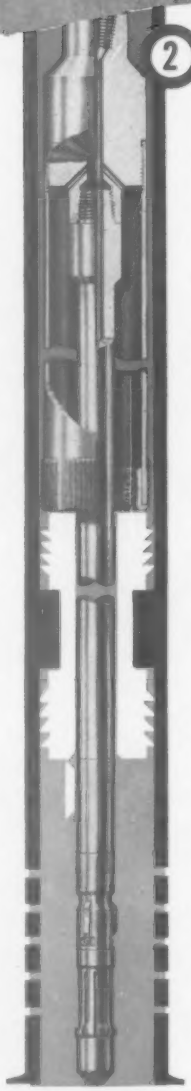
Services for the oil industry DOWELL
DIVISION OF THE DOW CHEMICAL COMPANY

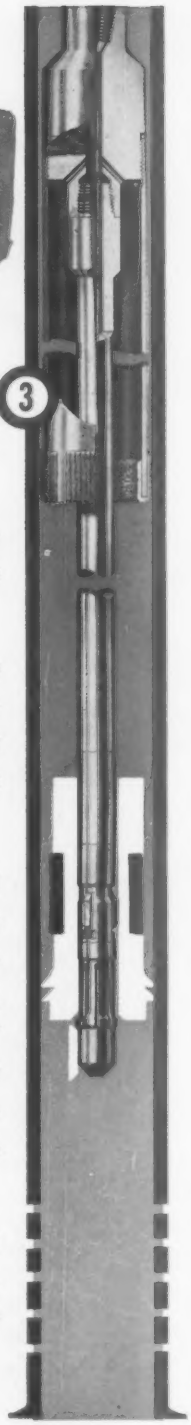
RECOVER DRILLABLE PACKERS IN ONE TRIP

with the

BOWEN PACKER RETRIEVER







Here's the safest, fastest way to recover drillable production packers. The Bowen Packer Retriever will engage, mill-out AND retrieve the production packer—all in a single run.

It's as simple as 1-2-3 — yet you can't lose the packer because the Bowen Retriever is in catching position when it passes through the packer bore. Bridge plugs, cement retainers, and packers can also be milled-out and pushed to the bottom, if retrieving is not required.

In operation, the Retriever (1) Passes through the bore of the packer, in catching position. (2) Mills over the packer. (3) Pulls the the packer.

An added feature: the Retriever is easily disengaged if necessary and re-set again, all without pulling from the hole.

A full range of sizes and connections is available: catch I. D.'s, 1.968" to 4.750"; top connections, 1-13/16" Wilson to 3½" API. Oversize parts (in stock) allow conversion to larger catch sizes up to 5".

Be ready. Send for your copy of the complete brochure on Bowen Packer Retrievers today.

Available from your service company domestically;
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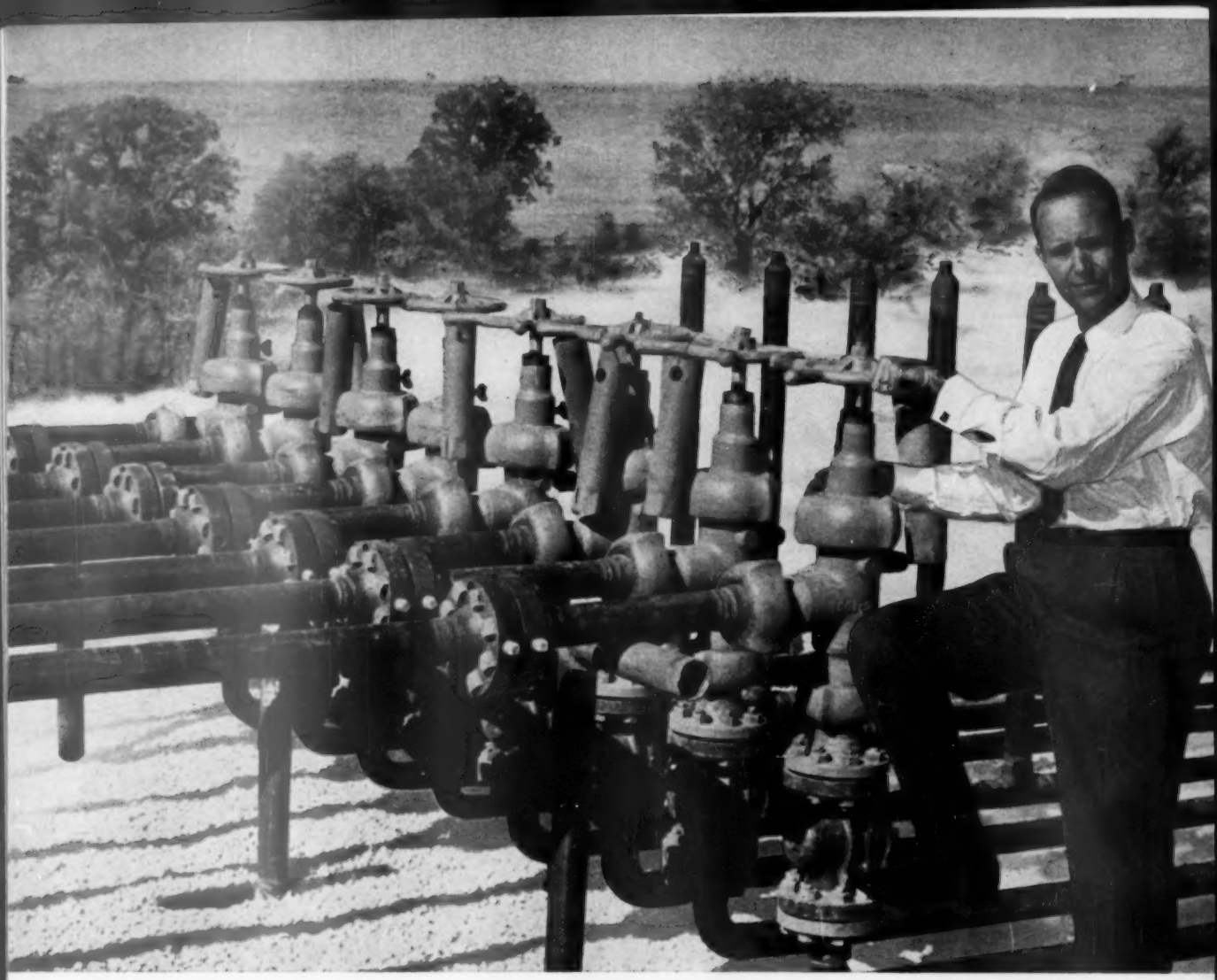
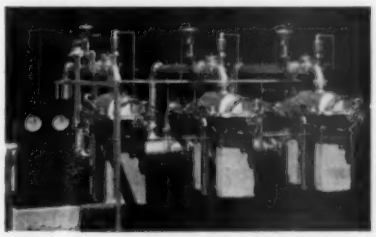


How an Oklahoma Operator Dried Up Valve Trouble On a Big Waterflood

This is a view of the water injection manifold on the Naval Reserve Field waterflood project in Oklahoma. In the beginning, this operation was plagued with valve troubles . . . until UNIBOLT Adjustable Valves were installed.

As is the case in many waterflood operations, the raw water at Naval Reserve is corrosive and abrasive. Cavitation of the fluid as it passes thru the valve has an eroding effect on the valve seats. However, since the UNIBOLT Adjustable Valve employs both the right design and the right materials, it has practically put an end to this Operator's valve troubles. For example, the stem and seat are of special analysis chrome steel, honed to mirror smoothness. And the stem is guided to the seat thru an extra long pilot that exactly centers it to insure a streamlined flow. Manufacturing details, perhaps, but added to dozens of similar features they add up to perfection and the one valve that is best suited for waterflood injection manifold and similar troublesome services.

Planning a waterflood or having valve troubles in your present system? Talk to the UNIBOLT representative in your area and get all the facts about this Adjustable Valve.



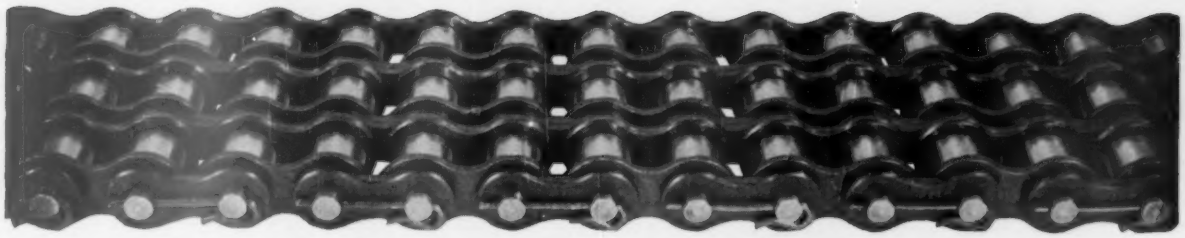
Three self-cleaning Jet Filters, manufactured by Thornhill-Craver Co., on a waterflood operation near Odessa, Texas. These Filters automatically clean raw injection water to any desired degree, even to sub-micron particle size.

THORNHILL UNIBOLT **CRAVER CO.**

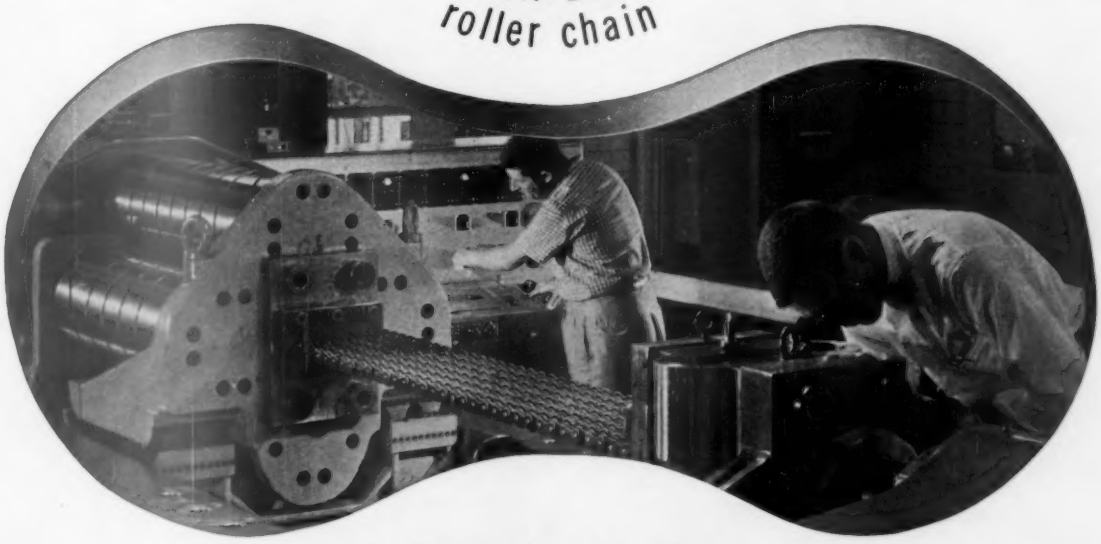
P. O. Box 1184, Houston, Texas

Why do sweater girls look to the oilman? Simple. He's responsible for the petroleum-based synthetic fibers that go into so many of the sweaters they wear. And for the petroleum-based synthetic dyes that are used to color them. Because of oil research, clothing for the whole family has better appearance and longer life. Each advance in oil technology gives you, the oilman, a greater stake in society. And gives you more reason to speak up when anyone speaks out against oil. Today, everyone enjoys the benefits of oil—one of nature's most versatile resources.

SHELL OIL COMPANY



Another of the invisible extras that insure MORE ON-BOTTOM TIME with LINK-BELT FR® roller chain



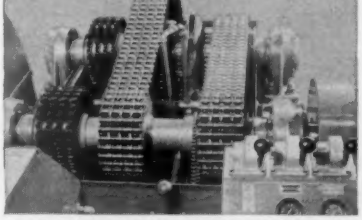
Cyclic-tension test verifies

top fatigue strength

Fatigue Resistant FR* processing of sidebars lengthens the life-span of Link-Belt roller chain. FR increases chain's endurance limit by compressing the metal around pitch holes . . . the critical sidebar areas most vulnerable to fatigue failure.

On the test equipment above—the industry's largest and fastest fatigue machine—Link-Belt has proved conclusively the superior fatigue resistance imparted to roller chain by the FR process. The machine produces up to 65 tons of cyclic tension. Rapid "stress-on, stress-off" action duplicates toughest conditions of rig operation.

From such facilities for research, production and quality control—plus extensive field testing—Link-Belt roller chain inherits invisible extras that withstand the grueling tensions of drilling service.



NATIONAL DUAL-ENGINE INDEPENDENT PUMP DRIVE incorporates quadruple-width Link-Belt Precision Steel roller chain with FR.

For engineering assistance in applying FR roller chain, write Link-Belt Company, Indianapolis 6, Indiana. Ask any leading supply store for our Catalog 2980 containing full information on roller chain and other oil field equipment.

**U.S. Patent No. 2,517,497*

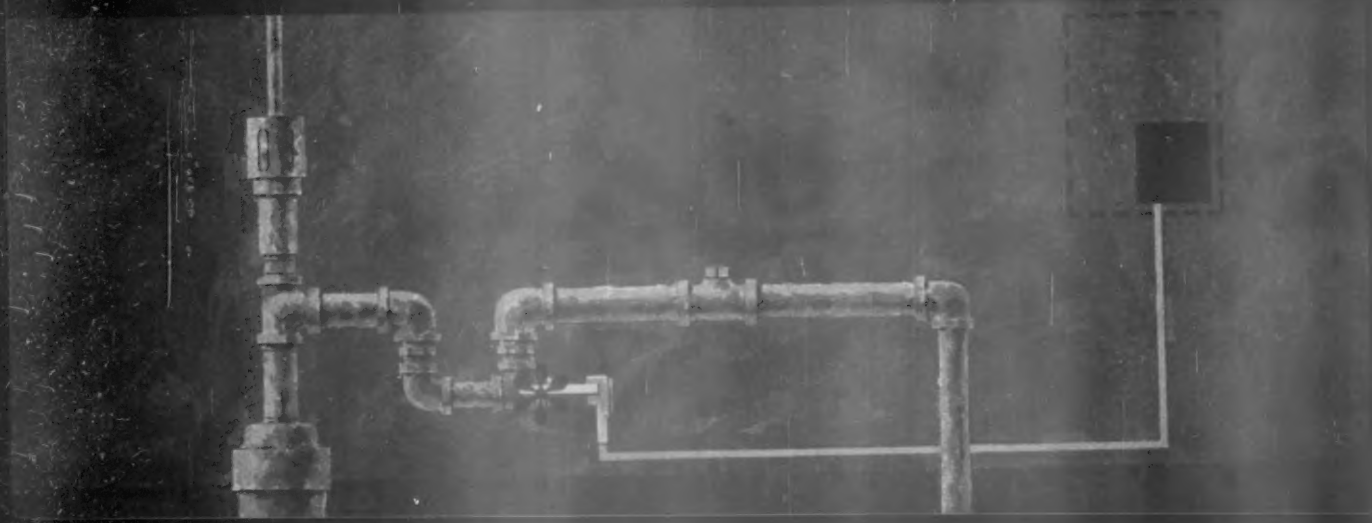
LINK-BELT COMPANY: Indianapolis 6, Houston 1, Dallas 26, Odessa, Tex., New Orleans 16, Shreveport, La., Los Angeles 22 (Montebello), Scarboro (Toronto 13); Export Office, New York 7. Distributors in All Fields. 18,573

LINK-BELT

ROLLER CHAINS AND SPROCKETS

New oil well control development from Cutler-Hammer

The Cutler-Hammer thermistor detects pump off, then signals transistorized relay which shuts off pump.



At last! An automatic pump off control that ends dry pumping!

- *Cutler-Hammer's exclusive pump off control for oil wells eliminates severe wear from dry pumping*
- *Cuts pumping time up to 25%, yet maintains maximum oil production . . . saves electricity, too*
- *Field tested for 2½ years . . . proved to lower oil lifting costs*

Now one of the biggest problems in oil well production is solved.

The new Cutler-Hammer Automatic Pump Off Control takes the guesswork out of figuring pump off time.

An ingenious sensing probe, (an electrically self-heated thermistor) measures fluid flow electrically. When the well pumps off, the thermistor signals the transistorized relay which in turn shuts off the pump. *Fluid flow* is the gauge—no other factors influence pump off.

You get maximum oil production without undue wear and maintenance. Even under rapidly changing well characteristics the pump off control matches pumping schedules to well production—a real aid to pumpers.

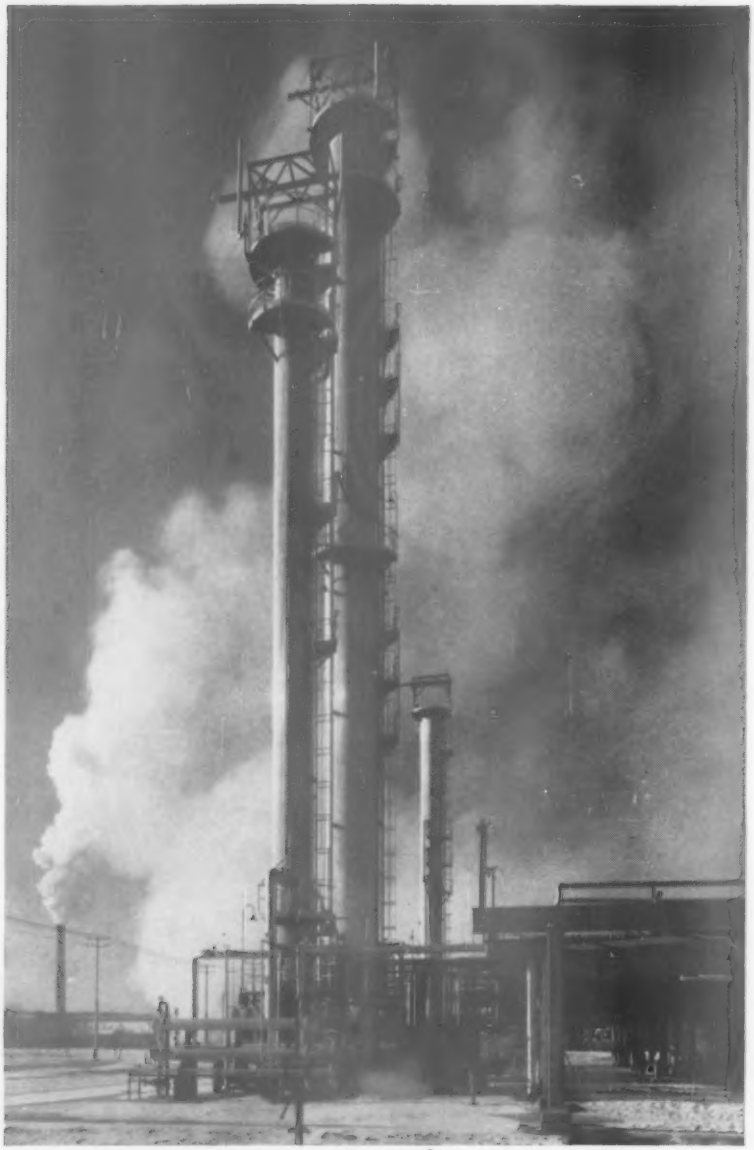
By preventing just one pump overhaul you save enough to pay for a half dozen or more Cutler-Hammer pump off controls. You can't afford to be without them. This unique control is easily installed with any size pump. Better get Pub. LO-16—E275 now for full details.

What's new? This new, *better* product is a typical example of what you can expect from the new Cutler-Hammer. We've added new plants, new engineering talent, even a new trademark that symbolizes our new capabilities for the demanding decade ahead. Find out more about our new problem-solving capabilities soon.

WHAT'S NEW? ASK...

CUTLER-HAMMER

Cutler-Hammer, Inc., Milwaukee, Wis. • Division: Airborne Instruments Laboratory • Subsidiary: Cutler-Hammer International, C.A. • Associates: Canadian Cutler-Hammer, Ltd.; Cutler-Hammer, Mexicana, S.A.



Towers for Texaco

When it comes to producing vessels of this kind, experience on the part of the fabricator is a great asset to the main contractor. To have a fully equipped plant is not enough. There must also be a very advanced knowledge of the actual techniques of steel fabrication. New materials and procedures are always being developed and to reap the benefits, they have to be properly applied.

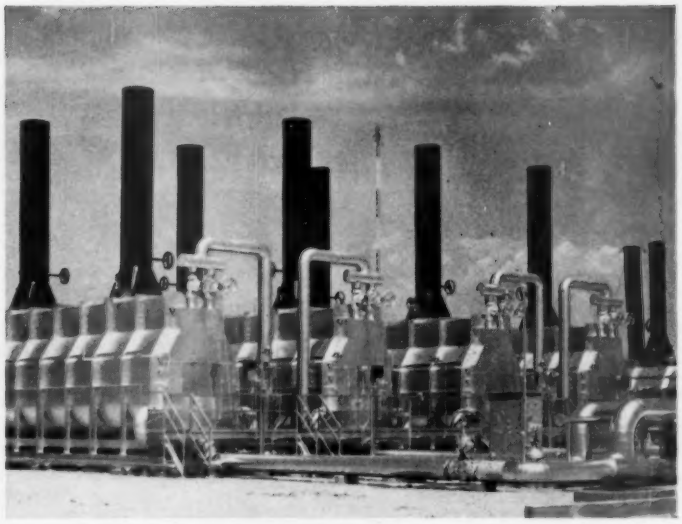
These towers were fabricated by the Platework Division of Dominion Bridge to designs supplied by Foster Wheeler and are typical of hundreds that Dominion Bridge has made for the oil and chemical process industries.

Dominion Bridge plants across the country are well experienced in this business and the sum total of this experience is applied to every new contract.

72

Platework by **DOMINION BRIDGE**

DOMINION BRIDGE COMPANY LIMITED - FIFTEEN PLANTS COAST-TO-COAST IN CANADA



100,000 to 200,000,000 BTU

PETROCHEM VERTICAL AND HORIZONTAL DIRECT FIRED HEATERS

For the petroleum, chemical and petrochemical industries, Yuba now offers the most complete series of direct-fired heaters available. From 100,000 to 200,000,000 BTU per hour – from –200° to +2,000° F – Petrochem Vertical and Horizontal Heaters can be built in every size and type for every use in any location!

Yuba Heaters are available from the most simple horizontal design to the famous Petrochem vertical with optional reradiation cones for even heat distribution and maximum efficiency.

Working closely with both customer and prime contractor, Yuba can provide single piece, shop-assembled horizontal heaters *to 30,000,000 BTU*. Other heaters up to 50,000,000 BTU can be provided in two sections. For field installations of larger heaters, Yuba can provide well-trained supervisory personnel when desired. Get the complete story on Petrochem direct-fired heaters from Yuba – your largest single, fully-integrated source of supply.

Other Yuba Products For The Petroleum, Chemical and Petrochemical Industries—Adsco Expansion Joints, Transaire Air-Cooled Heat Exchangers, Shell and Tube Heat Exchangers, Southwest Floating Roof Tanks, Cone Roof Tanks, Pressure Vessels, Field Erection, Columns and Towers, Process Condensers, Custom Fabrication.

YUBA

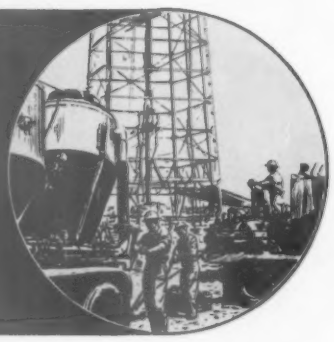
specialists in process heaters—every size, capacity and duty

YUBA HEAT TRANSFER DIVISION

YUBA CONSOLIDATED INDUSTRIES, INC.

Sales Offices in Chicago • Houston • Los Angeles • New York • Pittsburgh • San Francisco

HALLIBURTON'S *"well-designed"* CEMENTING TOOLS



For an unmatched combination of superior cementing tools and skilled cementing personnel... both bearing the name of the world's most experienced oil well cementing organization... specify HALLIBURTON for a better cementing job.

Because even the best tool is no better than the skill of its operator, Halliburton tools are effectively controlled by thoroughly trained and experienced Halliburton Cementers... men who know the design and purpose as well as the operation of the tools they use.

Put this profitable "work team" on your next cementing job. For "well-designed" tools and "well-experienced" cementers, the name to remember is Halliburton.

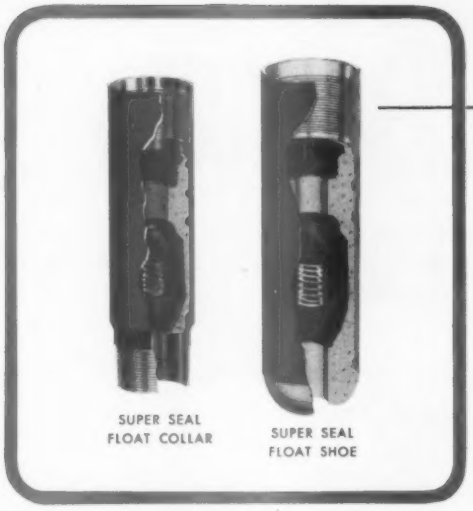
HALLIBURTON
SELF-FILL DIFFERENTIAL COLLAR

Simple construction, engineered for maximum speed, provides higher efficiency in automatic casing filling of well fluids, even in the deepest wells. The Halliburton Self-Fill Differential Collar, when placed above the Super Seal Valve, reduces running-in time. Provides greater protection for weak formations... helps eliminate low pressure areas below... operates effectively in drilling mud containing high percentages of lost circulation materials and cuttings. Circulation may be established, when desired, without tripping the Self-Fill Collar. Designed for use with Super Seal Floating Equipment.

Halliburton

COMPANY • DUNCAN, OKLAHOMA

THESE HALLIBURTON TOOLS...AND MANY OTHERS AID IN BETTER CEMENTING OF YOUR WELL



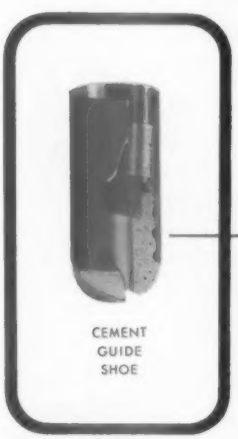
HALLIBURTON SUPER SEAL FLOATING EQUIPMENT

Meets all requirements for floating and cementing of casing—landing on bottom and circulating great volumes of fluid, holding slurry outside casing even in the deepest wells.

"Super Seal" Float Valve Assembly in Halliburton Float Collars and Float Shoes are recommended for any weight casing, through N-80 grade, to pressure equal to the collapsible pressure of such casing, provided weight ranges of both are matched. Composed of phenolic impact compound for greater compressive strength than normally required—is inert to most acids and solvents—is unaffected by known well fluids or temperatures up to 400°F. Held securely in steel coupling by high compressive and shear strength concrete—presents no "drilling-out" difficulty.

Fluid-flow areas allow maximum pumpability through valves and concrete guide nose even where high mixtures of cement or mud additives are required.

Rubber Cover on the Super Seal Valve is oil-resistant and helps to provide a "fluid-tight" seal, even after many continuous hours of high speed pumping of mud and cement with abrasive materials and additives. Also acts as a shock absorber for side-wise vibrations, protecting Back Pressure Valve from wear while pumping. Plug Seat Insert of impact plastic molded in concrete of Float Collars and Float Shoes in all standard sizes, provides a plug seat even greater than with concrete alone.



HALLIBURTON CEMENT GUIDE SHOE

The landing of the first joints of casing on bottom to be cemented may be hazardous. Safety is increased by installing a Cement Guide Shoe on the first joint. The strong, durable, rounded Guide directs the casing away from ledges to reduce side-wall caving, aids in safely passing through crooked holes, and penetrating temporary bridges.

HALLIBURTON WELD-A

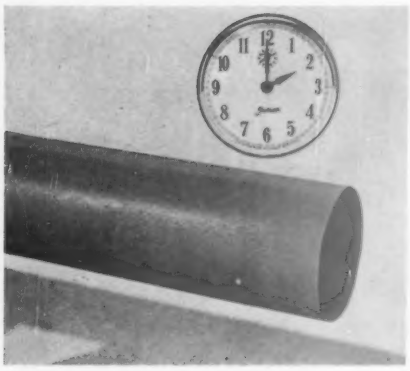
A thread compound proven superior to tack-welding for locking threaded connections tightly and permanently. Designed to provide necessary bond to prevent thread connections from backing out without welding. Halliburton Weld-A is convenient to use, economical and easily applied.

HALLIBURTON TURBO-JET GUIDE SHOE

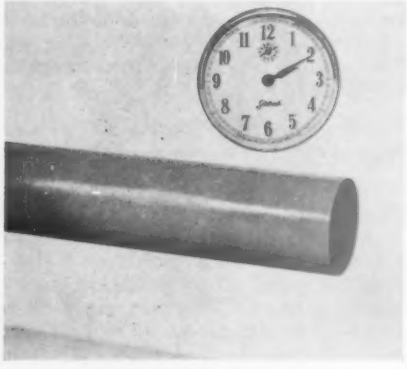
Guides strings of casing to bottom and has a built-in "rotor" which provides a forceful "jetting" action of fluid at shoe joint for better cement distribution around casing shoe and behind pipe to minimize channeling. "Jets-off" and washes mud-cake from hole bottom while rotating or reciprocating pipe—penetrates bridges while running casing—circulates fluid out through side ports when casing rests on bottom. All parts are drillable.

CEMENTING SERVICES

"A Well Worth Cementing Is Worth Cementing Well"



Only one spray coat of Dimetcote No. 4 is required. *No primer! No curing solution!*



Dimetcote No. 4 self-cures in a matter of minutes. Completely non-flammable and non-hazardous both during and after application. All the proven corrosion protection and weather resistance of Dimetcote No. 3—plus self-curing.

As soon as dry, Dimetcote can be handled the same as bare steel. If severe abuse should cause minor abrasions, the zinc content cathodically prevents rust.

Dimetcote® is now SELF-CURING!

Dimetcote No. 4 is a self-curing maintenance version of Dimetcote No. 3, the original inorganic zinc silicate coating in use since 1938.

- The 1-coat, 100% inorganic zinc silicate that is equal or superior to galvanizing
- Completely self-curing
- Non-flammable, non-hazardous both during and after application
- Excellent abrasion resistance and toughness
- Cathodically protects steel
- Insoluble in all petroleum products

The dry film of Dimetcote No. 4 is the same as Dimetcote No. 3, which is the most widely used and most successful coating of its kind. Used alone or as a permanent primer, Dimetcote No. 4 gives steel structures the same long-lasting protection against severe atmospheric exposure!

Technical data available on request.

Dept. CP • 4809 Firestone Boulevard • South Gate, California

Amercoat® CORPORATION

921 Pitner Ave., Evanston, Ill. | 360 Carnegie Ave., Kenilworth, N.J. | 111 Colgate Ave., Buffalo, N.Y. | 2404 Dennis St., Jacksonville, Fla. | 6530 Supply Row, Houston, Tex.

AMERCOAT NO. 99

When required for severe chemical exposures, Dimetcote plus Amercoat No. 99 provides a revolutionary 2-COAT system!

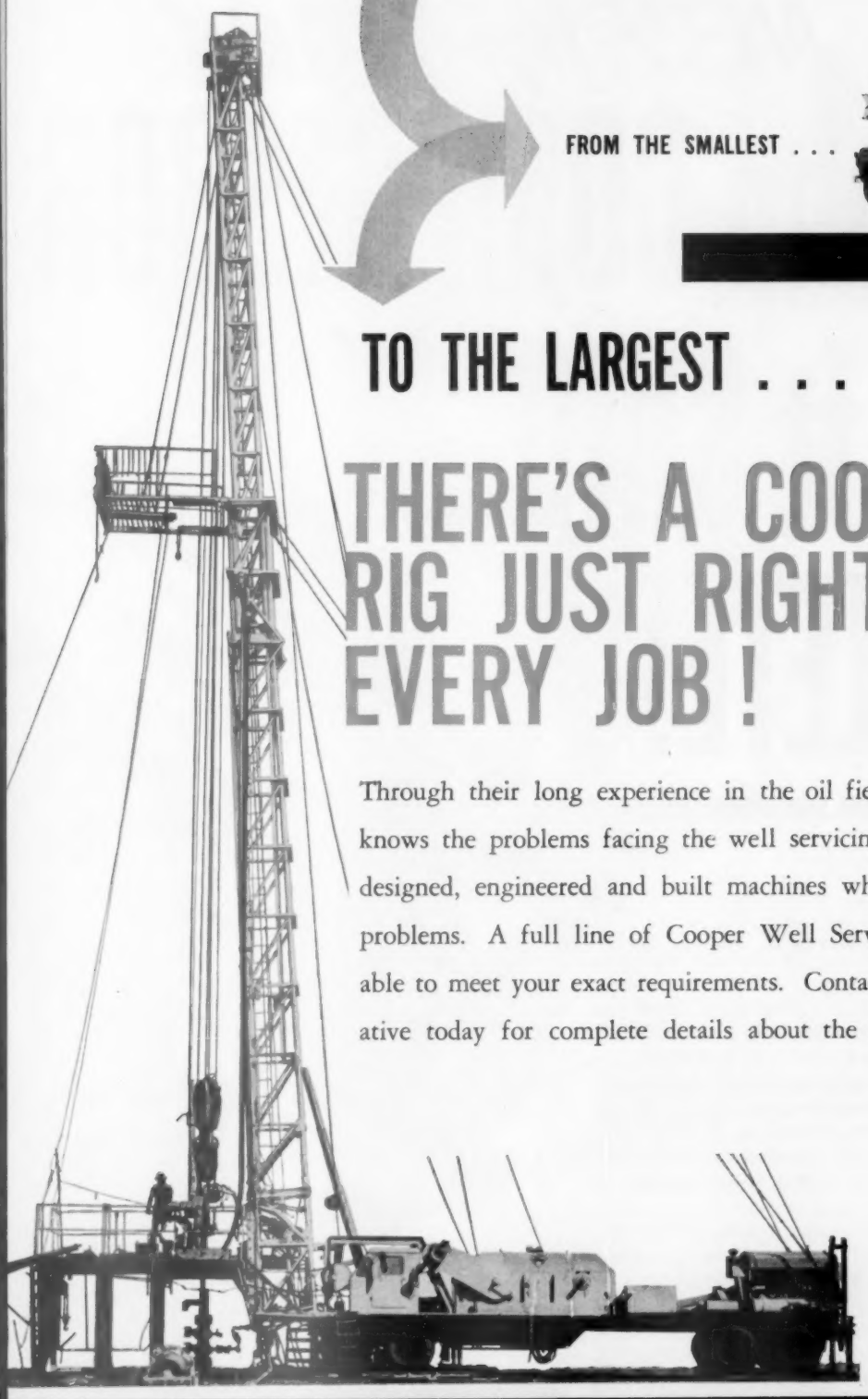
Amercoat No. 99 is a high solids vinyl that easily attains a 6-mil dry film thickness in one airless spray coat . . . a 5-mil thickness in two coats by conventional spray methods; forms a tough, flexible film with excellent chemical and weather resistance. Tests prove the Dimetcote/Amercoat No. 99 two-coat combination outperforms other maintenance systems — even those requiring up to 5 coats!

FROM THE SMALLEST . . .

TO THE LARGEST . . .

THERE'S A COOPER RIG JUST RIGHT FOR EVERY JOB !

Through their long experience in the oil fields, Fred E. Cooper, Inc., knows the problems facing the well servicing industry today and has designed, engineered and built machines which solve many of these problems. A full line of Cooper Well Servicing rigs are now available to meet your exact requirements. Contact your Cooper representative today for complete details about the Cooper line.



SINCE 1918 — THERE MUST BE A REASON

FRED E. Cooper, Inc.

P. O. BOX 1890 TULSA, Okla.

Branches: Houston, Odessa, Olney

NEW by CLARK

1000 bhp COMPRESSOR ON 35 ft SKID... COMPLETE!

It's called the Clark **VeePac** and you can see at a glance that here is the most compact, most versatile, most long-lived packaged compressor available today. Now you can have a unit up to 1000 bhp complete with radiator and all accessories mounted on a single skid only 35 feet long.

Designed For Field Service, offshore platforms and process use, the *VeePac* combines V-Engine compactness with the known reliability and simplicity inherent in Clark 2-Cycle design. The use of large blocks of horsepower in one package affords new savings in space, total units required, installation costs and operating expense.

Versatility is a key feature. Depending on the service, the *VeePac* can be equipped with compressor cylinders on one or both sides of the crankcase. For low suction pressure applications, as many as six large compressor cylinders can be used.

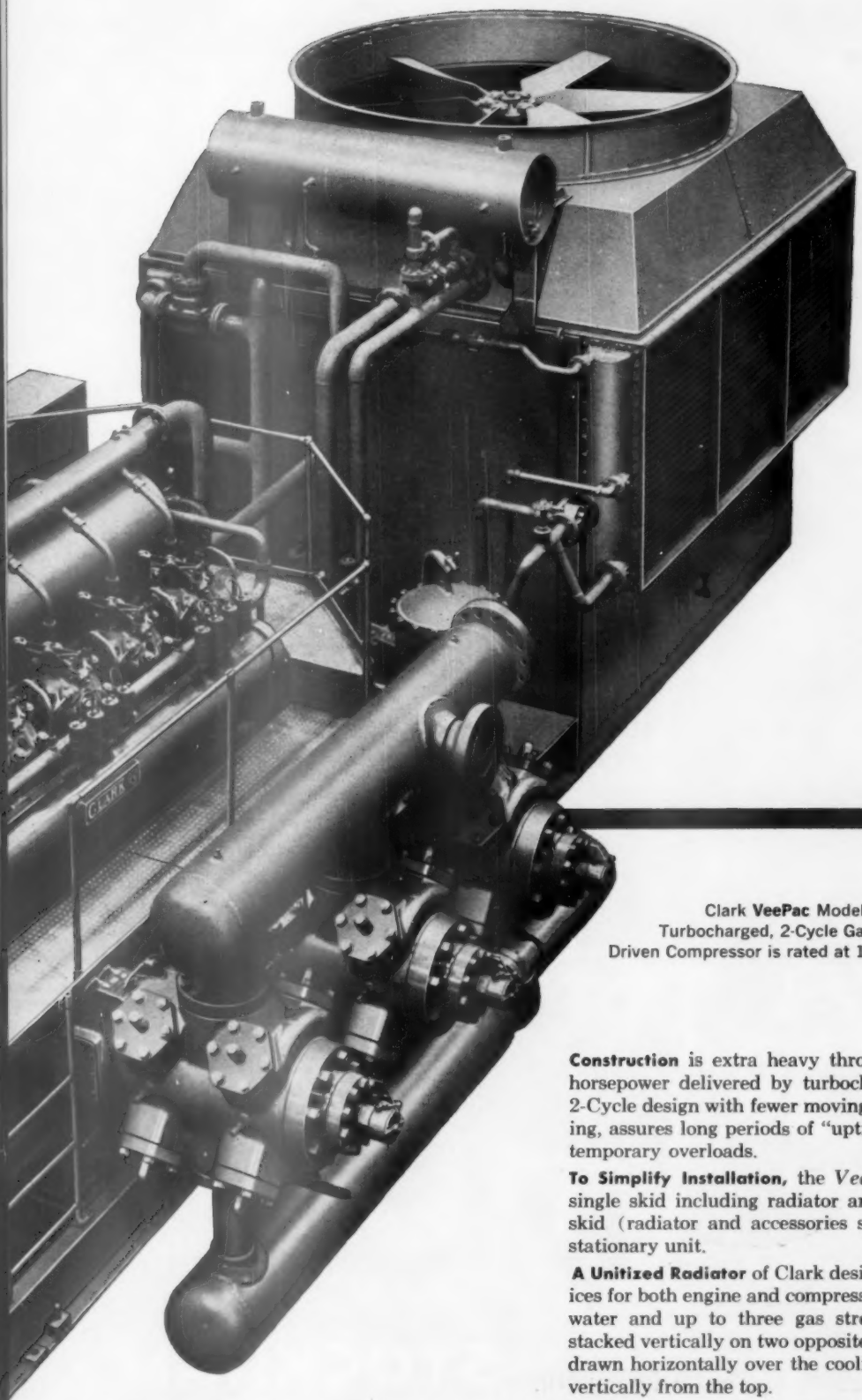
A Constant Pressure Turbocharger packs vast amounts of scavenging air into the combustion system, thereby boosting power output, reducing fuel consumption and lowering cooling duty. Completely automatic in operation, it tailors the air supply to engine demands over the entire operating range.

Variable-Speed, Variable-Load applications present no problem. An automatic ignition timing control combines with the turbocharger to provide exceptionally good response, good speed control, and low fuel consumption over a wide range.

CLARK®

DRESSER INDUSTRIES INC.

OIL • GAS • CHEMICAL
ELECTRONIC • INDUSTRIAL



Clark **VeePac** Model TVM-12,
Turbocharged, 2-Cycle Gas-Engine-
Driven Compressor is rated at 1000 bhp.

Construction is extra heavy throughout to handle the high horsepower delivered by turbocharging. In addition, Clark 2-Cycle design with fewer moving parts and conservative rating, assures long periods of "uptime" plus ample reserve for temporary overloads.

To Simplify Installation, the *VeePac* can be mounted on a single skid including radiator and all accessories, a duplex skid (radiator and accessories separate), or supplied as a stationary unit.

A Unitized Radiator of Clark design provides all cooling services for both engine and compressor including lube oil, jacket water and up to three gas streams. Cooling sections are stacked vertically on two opposite sides of the radiator. Air is drawn horizontally over the cooling surfaces and discharged vertically from the top.

Available in Two Sizes—10 and 12 power cylinders rated at 825 and 1000 bhp respectively, the Clark *VeePac* Model TVM is designed to help you boost the efficiency of every compressor dollar you spend. For full information, contact your nearest Clark office or write for new illustrated Bulletin 191.

CLARK BROS. CO.

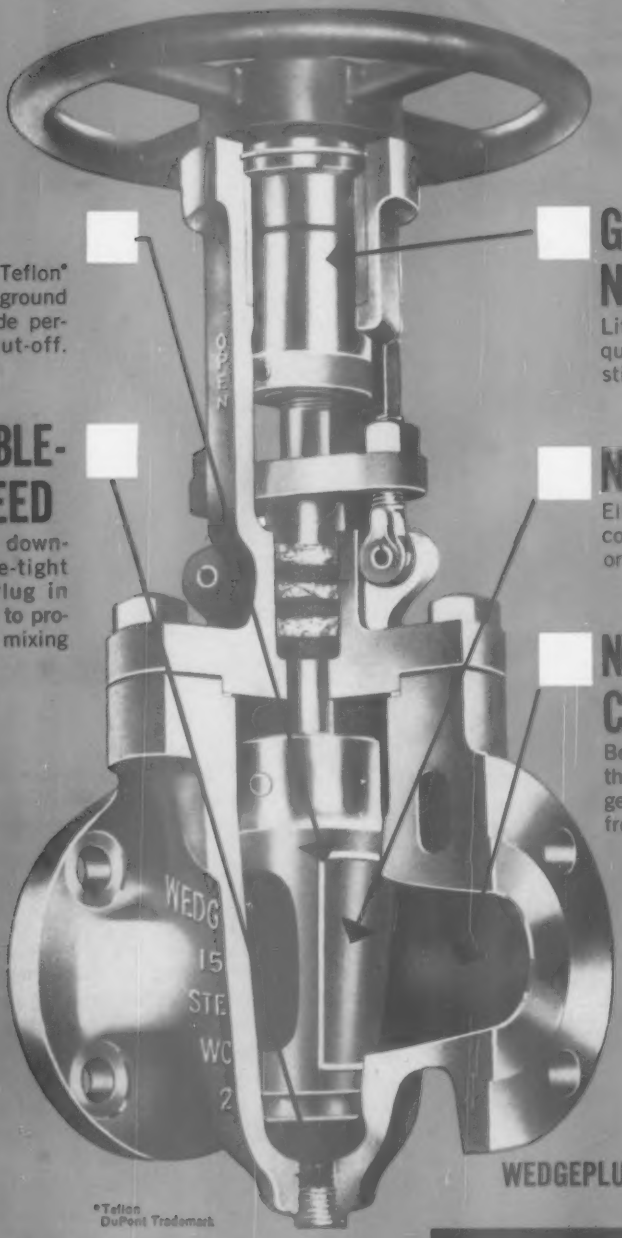
OLEAN, N. Y.

Engines Compressors Gas Turbines

CHECK THE WAYS

YOU'LL SAVE MONEY

WITH STOCKHAM'S WEDGEPLUG O-SEAL VALVE



NO LEAKAGE

Pressure-sealing effect of Teflon* "O" rings in the plug plus ground metal-to-metal seats provide permanent bubble-tight shut-off. Safe in case of fire.

PROVIDES DOUBLE-BLOCK AND BLEED

Both the upstream and downstream seats hold bubble-tight against line pressure. Plug in bottom-boss can be pulled to provide bleed. Absolutely no mixing of products on manifolds.

GUARANTEED NOT TO STICK

Lift-type plug engineered for quick, easy operation. Will not stick.

NO LUBRICATION

Eliminates the high monthly cost of lubricants and labor, or a lubricating service.

NO PRODUCT CONTAMINATION

Because it's non-lubricated, the O-Seal eliminates the danger of product contamination from plug seal lubricants.

*Teflon
DuPont Trademark

AVAILABLE THROUGH YOUR LOCAL STOCKHAM DISTRIBUTOR

WEDGEPLUG VALVE COMPANY
DIVISION OF

STOCKHAM
VALVES *and* FITTINGS

General Offices and Plant
4000 North 10th Ave. • Birmingham 2, Alabama

From Du Pont...TETRAMIX* for greater refining flexibility

In the brief few months since the introduction of Du Pont TETRAMIX* antiknock compound, refiners have found that it offers a new degree of flexibility in their choice and use of lead antiknocks. For example, while its effectiveness varies with gasoline composition (as is true with other antiknocks as well), TETRAMIX is generally effective in low, medium and high dosages.

Results of tests to date indicate that TETRAMIX is also a more effective antiknock in some fuels than either tetraethyl or tetramethyl lead —that is, a given octane number can, in such fuels, be obtained with lower concentrations of TETRAMIX than with TEL or TML.

Based on this refining flexibility and the potential savings it offers in blending, TETRAMIX antiknock compound has already won refiners' acceptance. With commercial quantities available, now is the time for *you* to investigate the potential advantages of TETRAMIX.

Because you have a choice of all three major lead antiknocks at Du Pont, you'll get impartial help in selecting the best one for *your* gasoline stocks. Your Du Pont Petroleum Chemicals Division representative can assist you in evaluating the relative merits of TEL, TML and TETRAMIX.

E. I. du Pont de Nemours & Co. (Inc.), Petroleum Chemicals Division, Wilmington 98, Delaware.

*Trademark

DU PONT
REG. U.S. PAT. OFF.
Better Things for Better Living
. . . through Chemistry

Lead Antiknock Compounds *and other* PETROLEUM ADDITIVES

AT COSDEN . . .

After five years' experience in operating Combin-aires, Cosden Petroleum Corporation, at its Big Spring refinery, has installed its FOURTH Hudson Combin-aire.

The Combin-aire is an integrated structure combining a water cooling tower with fin-tube hot fluid to air exchangers. Ambient air is cooled as it is drawn thru the water, and the cooled air serves as the cooling medium for the fin-tube coolers. Thus, with fin-tube coolers, effluent process stream temperatures may be reduced far below those obtained with ambient air.

The Combin-aire may be used primarily as a cooling tower, with the advantages of double use of air, and, because hot effluent air is undersaturated, complete elimination of spray carry over or condensation. Or when water is scarce, or salt, or brackish the Combin-aire may be used primarily for fin-tube cooling, using minimum water of any quality for pre-cooling air.

DEPENDING UPON DESIGN OBJECTIVES THE COMBIN-AIRE MAY HAVE SOME OR ALL OF THE FOLLOWING ADVANTAGES:

- Absolute minimum water consumption consistent with attainment of low terminal process stream temperatures.
- Water circulation may be made automatically responsive to air temperatures with no water circulated except at high ambient temperature.
- No water treatment necessary. Salt water or brackish water may be used.
- No spray carryover or condensation. After passing across the fin-tube elements the heated air leaving the Combin-aire at elevated temperature is undersaturated with water vapor and cannot precipitate condensate or carry water spray.
- Minimum piping. Combin-aire may be installed immediately adjacent to other process equipment.
- Clean air to fin-tube units. During the hot season air is washed, removing dust, sand and insects.

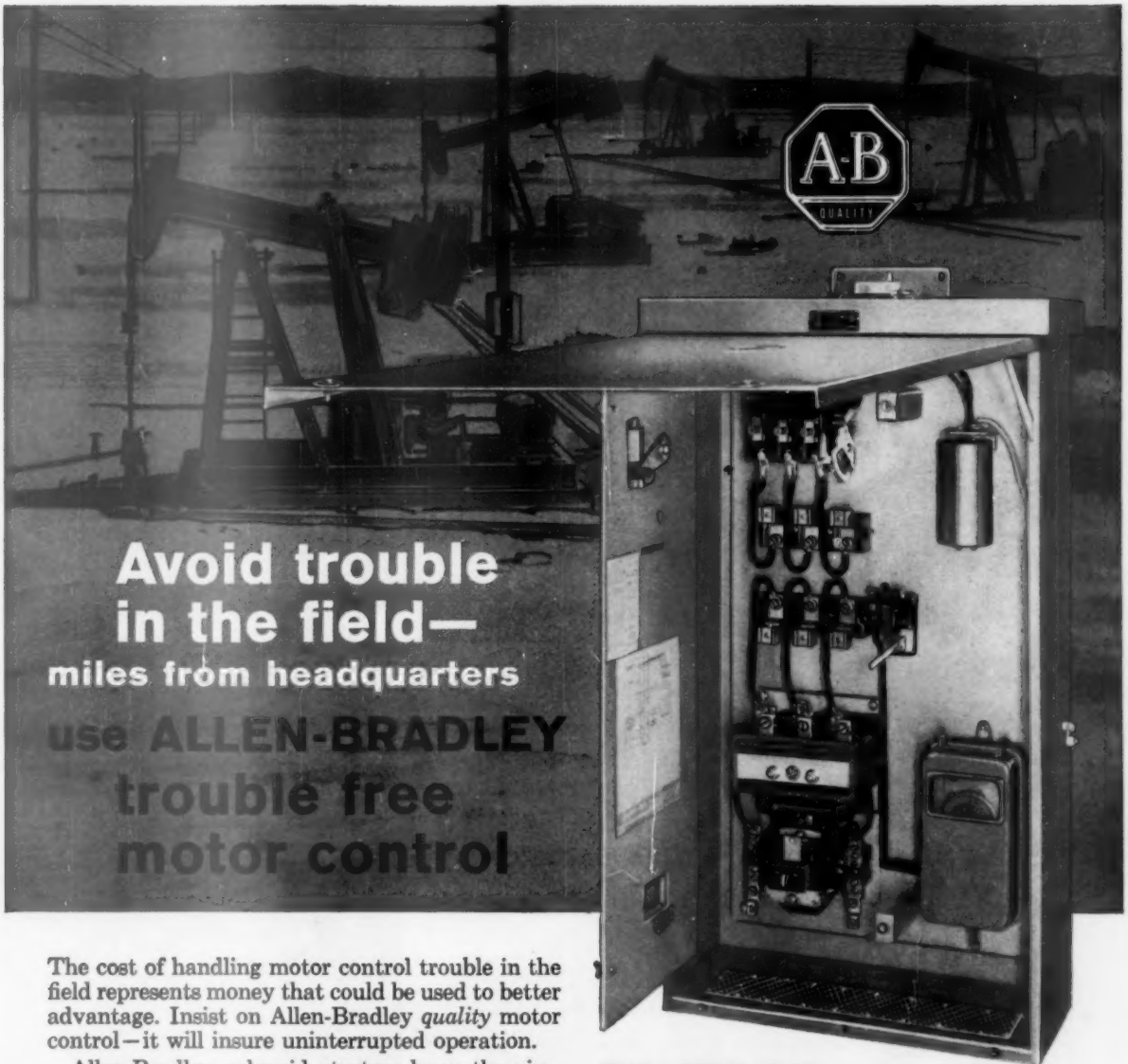
Effluent temperatures of process streams may be accurately controlled with HUDSON Auto-variable pitch fans.

HUDSON

ENGINEERING CORPORATION

BRAEBURN STATION • HOUSTON, TEXAS

OFFICES: 16033 Ventura Blvd. Encino, California • 122 East 42nd St. New York 17, N. Y. • 199 Bay Street Toronto, Ontario, Canada • 17 Stratton St. Piccadilly London W. 1, England • Corrientes 1115 Buenos Aires, Argen • Rua Mexico 45 Rio de Janeiro, Brazil



The cost of handling motor control trouble in the field represents money that could be used to better advantage. Insist on Allen-Bradley *quality* motor control—it will insure uninterrupted operation.

Allen-Bradley solenoid starters have the simplest switching mechanism yet devised—there is only ONE moving part. Such design simplicity is, in itself, a safe guarantee for millions of trouble free operations. Trouble-causing bearings, pivots, and flexible jumpers have all been eliminated.

The double break, silver alloy contacts—standard on *all* A-B controls—never need service attention of any kind. Allen-Bradley starters are equipped with two or three reliable and permanently accurate thermal overload relays.

To insure that your remote installations "stay on the job" without attention, insist on Allen-Bradley—the quality motor control that's built to be installed and forgotten.

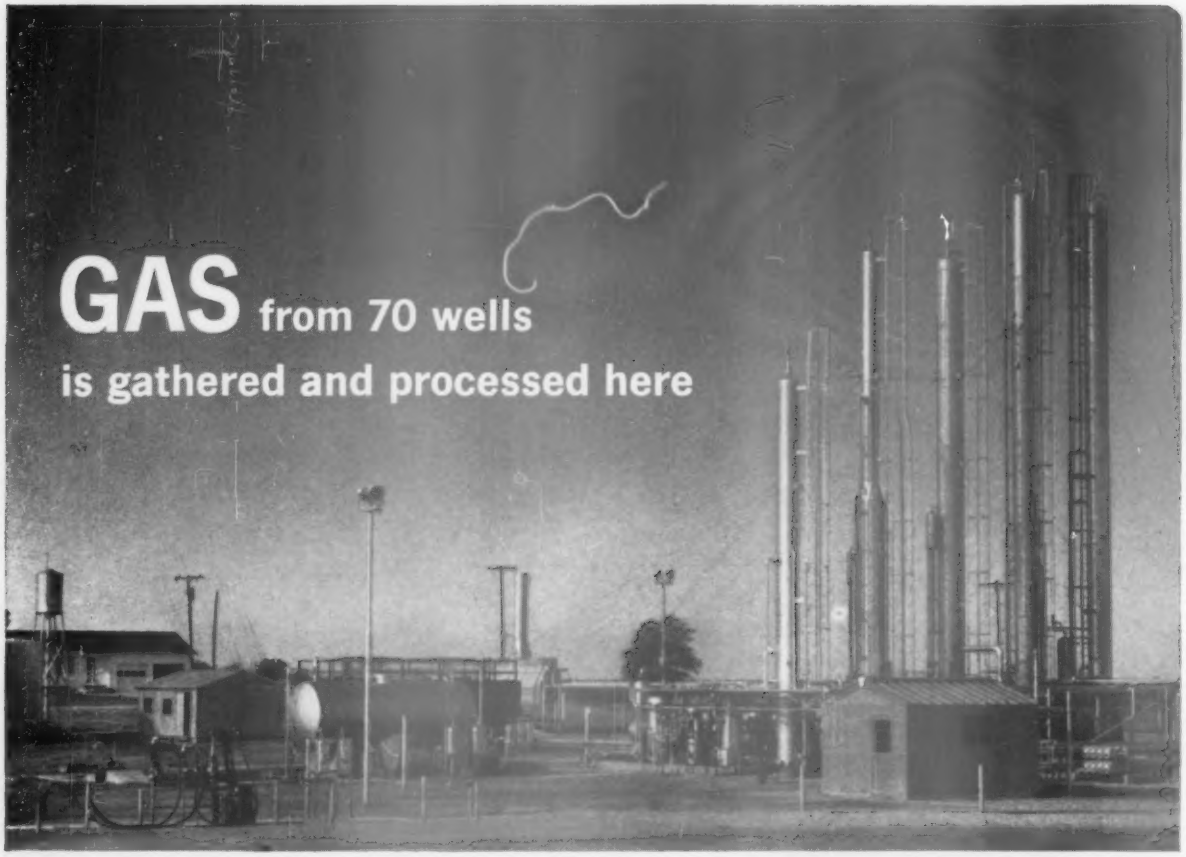
BULLETIN 1242

control panels are complete units for automatic operation of oil well pumps. A similar line—Bulletin 1232-3 for irrigation and other pumping requirements—is available. All use the popular A-B solenoid contactor with maintenance free contacts. Accurate overload relays insure safe pump operation up to rated capacity—without nuisance dropouts. The fused disconnect switch, contactor, overload relays, and undervoltage relay are in one compartment, and the door cannot be opened unless the switch handle is in the OPEN position. Lightning arrester and program timer are also included. The NEMA Type 3 enclosure provides reliable protection in all types of weather. Bulletin 1243 pump control panels have the same features but use ITE instantaneous trip circuit breaker as disconnect means. Send for Publication 6089.

Allen-Bradley Co., 1304 S. Second St., Milwaukee 4, Wis. • In Canada: Allen-Bradley Canada Ltd., Galt, Ont.

ALLEN-BRADLEY
Member of NEMA

QUALITY
MOTOR
CONTROL



"JENKINS valves give us the dependable performance our operations demand."

— states Kerr-McGee Oil Industries, Inc., Oklahoma gas producer

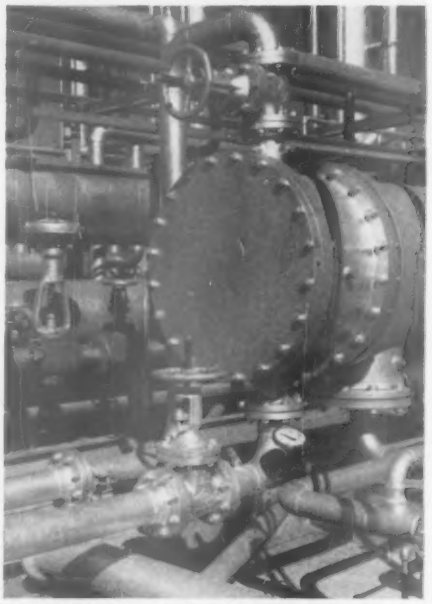
How Kerr-McGee's field processing plant in Lincoln County, Oklahoma, gathers and extracts valuable hydrocarbons from gas before delivering it to the consumer is an interesting story, briefly told below. But you need not know the process to appreciate the fact that maximum reliability in valves is a "must".

The valves that assure Kerr-McGee of dependable, trouble-free performance bear the same name as that written on piping lay-outs of critical jobs of all kinds for almost a century. Experienced engineers, contractors and operating executives know that "JENKINS" stands for an extra-measure of quality. They know it is the best guarantee of long, trouble-free service. There's no extra cost attached to this specification for extra quality, so you can use it for any job. Jenkins Bros., 100 Park Ave., New York 17.

HOW THE GAS PROCESSING PLANT WORKS...

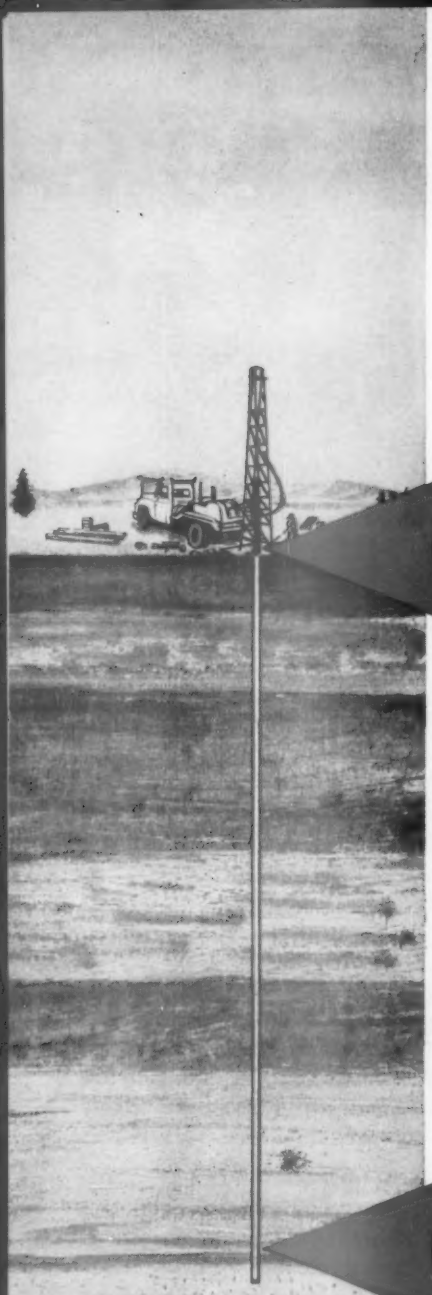
Because it is a vapor at low pressure, gas is first compressed and injected into the bottom of a tall tower, called an absorber; oil is injected at the top. As the oil goes down, the gas goes up . . . the gas products are absorbed by the oil. The gas enriched oil is then processed to remove valuable light hydrocarbons.

Sold Through Leading Distributors Everywhere



Jenkins Gate Valves on lean oil cooler to the absorber

JENKINS
LOOK FOR THE JENKINS DIAMOND
VALVES
JENKINS SINCE 1864 Jenkins Bros



Layne SINCE 1882

Layne Vertical Turbine Pumps are designed, engineered and manufactured by Layne in Memphis, Tennessee and nowhere else. Because pumping needs vary, there is a Layne pump for every pumping requirement—from 30 to 100,000 G.P.M. in sizes from 4 to 42 inches. Layne Pumps include Deep Well and Short Coupled (oil or water lubricated), Propeller, Mixed Flow, Regular and "In-Line" Submersible. For additional information write for bulletins 200-oil lubricated or 201-water lubricated.

has the only complete service that means

Water

The Layne Gravel Wall Well is an example of Layne experience, engineering and research. This gravel packing and 134 shutter screen employment affords larger screen openings, reduced friction, reduced draw down and pumping head. It increases specific capacity and makes for more effective retention of native sands. For additional information write for bulletin 900.

From top to bottom, you can depend on Layne for the most complete water service in the industry. This complete service provides undivided responsibility for the delivery of water . . . of the quality and in the quantity required. Over 75 years of *growing* service gives the skill and technical know-how which makes Layne First in the field of water. For additional information write for bulletin 10.

LAYNE OFFERS COMPLETE WATER SERVICE:

Initial Surveys • explorations • recommendations • site selection • foundation and soil-sampling • well drilling • well casing and screen • pump design, manufacture and installation • construction of water systems • maintenance and service • chemical treatment of water wells • water treatment—all backed by Layne Research.

Layne services do not replace, but coordinate with the services of consulting, plant and city engineers.

Layne SINCE 1882 — COMPLETE WATER SERVICE

LAYNE & BOWLER, INC., MEMPHIS

General Offices and Factory, Memphis 8, Tenn.

LAYNE ASSOCIATE COMPANIES THROUGHOUT THE WORLD

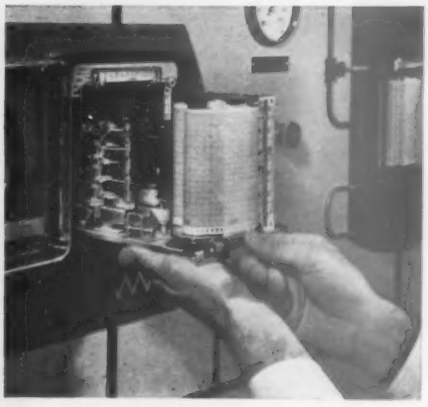
SALES REPRESENTATIVES IN MAJOR CITIES

ANOTHER

Money Saving Feature

OF

Taylor Instruments



"PLUG-IN" CONVENIENCE

Pioneered by Taylor ten years ago, the "plug-in" idea applies both to complete instruments and to components. For example, TRANSCOPE® Controllers plug-in to the backs of Recorders and Indicators and component parts plug-in to main assemblies. It is a dependable design feature of both the pneumatic and the electronic lines of TRANSCOPE instruments, proven by ten years' field experience.

Here are some of the important ways you benefit from this Taylor feature:

PLUG-IN INSTRUMENTS

- **Faster installation**—because housings with manifolds can be installed and connected while recorder and controller mechanisms are being manufactured.
- **Interchangeability of instruments**—a recorder can be quickly substituted for an indicating receiver when process trends need to be studied.
- **Minimum process interruption**—because a faulty instrument can be replaced in seconds.
- **More efficient maintenance**—instruments that require servicing can be taken to the shop, where complete facilities are available. This also means fewer highly skilled personnel are needed.

PLUG-IN COMPONENTS

- **Continuous control,** even when any one of the major assemblies is removed from the electronic recorder or controller, or the pneumatic recorder.
- **Quick conversion** for use with different primary elements, in the case of the 700T Potentiometer Transmitter. Just plug in the appropriate service "can".

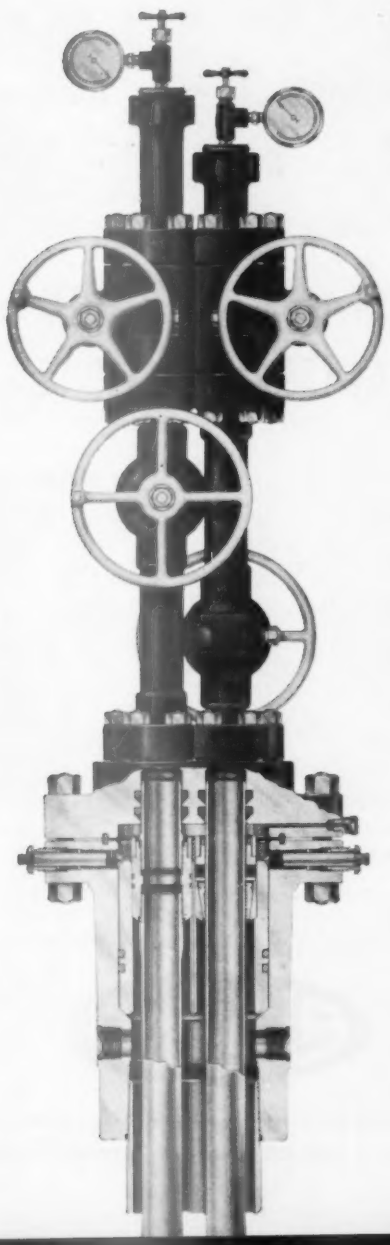
* * *

Plug-in is another example of Taylor engineering ingenuity . . . of attention to detail that saves you money, gives you better process control. See your Taylor Field Engineer, or write Taylor Instrument Companies, Rochester, New York, or Toronto, Ontario.

Taylor Instruments
MEAN ACCURACY FIRST

NOW-from O·C·T

greater flexibility and simplicity in tubingless completion equipment



The challenge was tubingless completion equipment featuring simplicity, flexibility, utility and "controllability." And here is the answer.

- Hangers are interchangeable. Thus, one, two, three or four strings of tubing can be hung in a head simply by changing hangers. Moreover, screwed or slip type interchangeable hangers are provided. Regular hanger couplings can be provided with or without the back pressure grooves.
- The complete series of hangers is produced to fit O-C-T Type CM, C-18, or C-19 Casing Heads and hangers for C-18 and CM heads are interchangeable. All hangers are designed to allow conventional cementing procedures, even providing for reciprocation of the tubing while cementing and simultaneously cementing through two or three strings of tubing.
- The Christmas Trees for use with O-C-T tubingless completion equipment can be provided with screwed connections, individually flanged connections or block type valves in the case of duals, triples or quadruples.
- For use with the several types of trees, O-C-T manufactures a complete line of 2½-inch tubing heads in which ¾-inch through 1½-inch tubing can be hung with any one of a complete family of interchangeable hangers.
- All hangers are designed to be run through blowout preventers.
- Available in pressure ratings up to and including 10,000 psi working pressure.

If you want to take advantage of tubingless completion on your next well, talk to the O-C-T representative nearest you. He can show you the best in tubingless completion equipment.

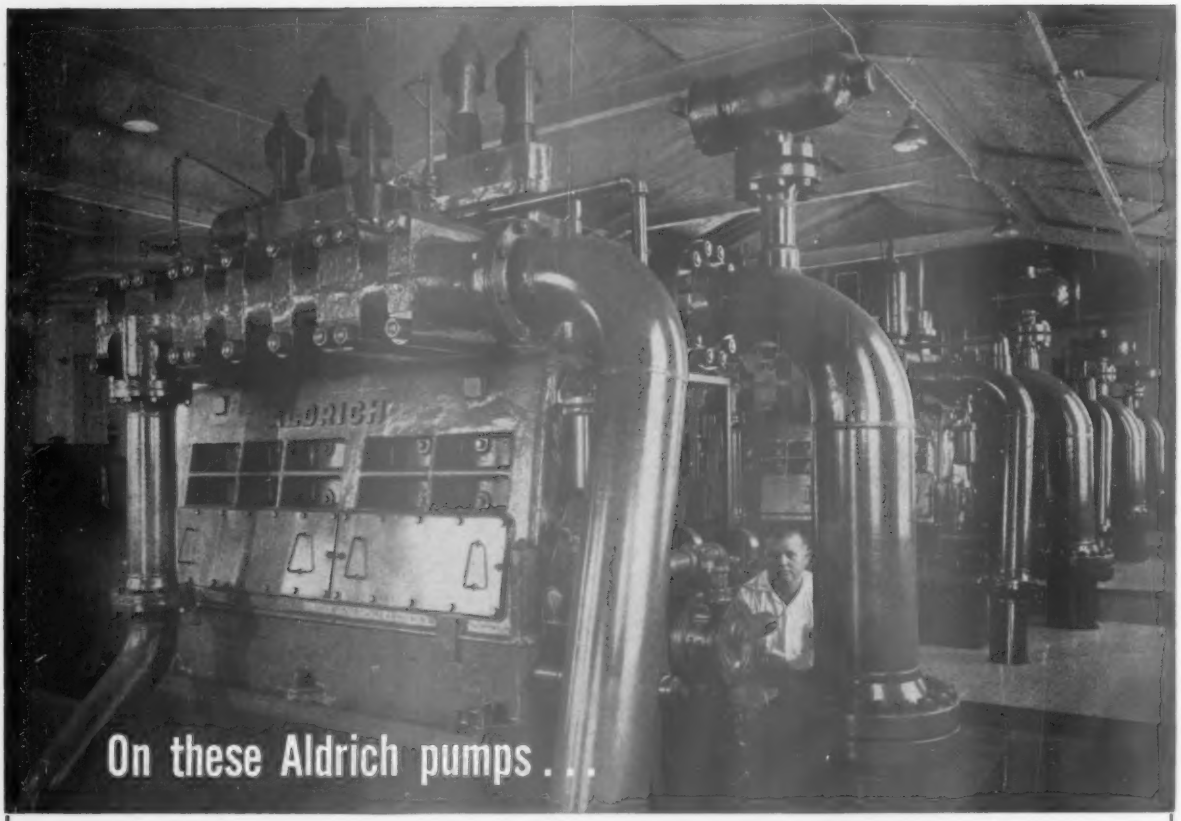
O·C·T

OIL CENTER TOOL CO.

SUBSIDIARY OF FOOD MACHINERY AND CHEMICAL CORPORATION

Address Export Inquiries for All Countries to
P. O. Box 3091, Houston, Texas.

where progress is a daily practice



GULF OIL REPORTS 6 YEARS OF CONTINUOUS SERVICE WITH MINIMUM MAINTENANCE

FIELD REPORT

FLOOD: Goldsmith-San Andres Unit
OPERATOR: Gulf Oil Corporation
PUMPS: 4 Aldrich Quintuplex
FLOODING STARTED: October, 1954
EXPERIENCE TO DATE:

After six years, three pumps operate 24 hours a day, delivering some 54,000 bbl/day of sour oil field brine at 750 to 800 psi. Station designed for automatic operation. All maintenance handled by one man during eight-hour work day.

Field Parts stock available in Houston, Odessa, Alice and Wichita Falls, Texas; Casper, Wyo.; Hobbs, N.M.; Carmi, Ill.; Charleston, W. Va., Tulsa, Okla.; Los Angeles, Calif.; Calgary, Ontario. For further information write the ALDRICH PUMP COMPANY, 9 Gordon Street, Allentown, Pa.

the tough pumping problems go to ALDRICH

3 fluids open the way to better frac jobs and faster pay out!

HUMBLEFRAC®

1. HUMBLEFRAC CONCENTRATE—a unique *liquid* fluid-loss additive easily measured into the fracturing oil to get the optimum blend. Contains no solids that could cause plugging or other formation damage. Frac fluid return is quick . . . more fluid is left in the fracture, extending it and allowing good sand propping.

2. HUMBLEFRAC BASE OIL—offers high sand-carrying ability even under extreme temperature and pressure, yet is easily handled at lower temperatures.

3. HUMBLEFRAC FRACTURING FLUID—ready-to-use mixture of concentrate and base oil, custom-blended to your specifications.

FOR COMPLETE TECHNICAL INFORMATION, call your Humble salesman or contact Humble Oil & Refining Company, Houston, Texas.

America's Leading ENergy COmpany

HUMBLE

How to buy a ball valve!

Check these features!

	FLO • BALL	VALVE A	VALVE B	VALVE C	VALVE D	VALVE E
1. TOP ENTRY	√			√		
2. IN-LINE MAINTENANCE	√			√	√	
3. TOP AND BOTTOM GUIDED BALL	√					
4. DOUBLE SEATS	√	√	√	√	√	√
5. FLANGES INTEGRAL WITH BODY	√	√		√		
6. ONE-PIECE BALL AND STEM	√					
7. BLOCK AND BLEED	√					
8. COMPETITIVELY PRICED	√	√	√		√	√

Only FLO·BALL has all 8

In addition to these outstanding features, the **FLO•BALL** valve, with all teflon seats and seals, offers all of these advantages which make it far superior to other types of valves: fast ¼ turn, minimum pressure drop, leakproof shut-off, visible on-off indication, no backlash, and the lowest torque of any valve. The **FLO•BALL** can never stick or freeze, and it lasts longer, with less maintenance, than any other valve made.

HYDROMATICS offers the most complete line of industrial ball valves, including 1" through 14" flanged, 150#, 300# and 600#, all built to ASA dimensions. Also available: ⅛"—2" screwed end valves to 3000#.

HYDROMATICS is the world's most experienced ball valve manufacturer, having built ball valves to 10,000 psi and 14". See your local distributor for details and prices, or write to:

Hydromatics, Inc.

BLOOMFIELD, N. J. • PILGRIM 8-7000 • TWX = BLOOMFIELD, N. J. 120

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FLO-BALL

a christmas tree is only as strong as its weakest seal

Rector makes the hook-up that is Sealed with Steel throughout

Rector wellhead equipment is designed to insure a leak-proof seal at all connections. Compare Rector's metal-to-metal seal features with any equipment on the market using resilient packing between casing and tubing strings. The Rector principle of reinforcing temporary organic packing with a permanent ring of steel insures a positive leak-proof completion every time. Rector's built-in welding ring coupled with an API ring gasket is easy to install, immune to corrosion inhibitors, will not flow under high pressure or temperature, will not freeze or contract under low temperature, will not burn out, and never requires maintenance or replacement.

There are no weak links in your completions, when you specify Rector equipment at your favorite supply store, or from your Rector representative.

30 YEARS MAKING THE OIL INDUSTRY SAFER

Rector

Well Equipment Co., Inc.

Making the Oil Industry Safer!

MONOGRAMMED EQUIPMENT CERTIFICATE NO. 2158

1100 North Commerce, Fort Worth, Texas Houston Plant: 2215 Commerce Street

EXPORT REPRESENTATIVES: Continental-Emsco Co., Mid-Continent Supply Co., Oilwell Division of United States Steel Corporation

Storage can be simple

A phone call to General American solves all *your* bulk liquid storage problems.

General American has *six* terminals close to the nation's top markets, where you can *lease* as much or as little tankage as you require.

When you store with General American, you have no capital investment, no operating problems. You have *flexibility* of inventory and product to meet your needs and the market's opportunities. Tanks can be bonded, if desired. You enjoy complete privacy, with experienced crews on hand to operate individual pipe lines. Blending and packaging equipment, loading docks and other facilities are available as needed.

Your warehouse receipts are A-1 collateral.

Ask the nearest General American office about terminal facilities.

It pays to plan with General American.

Terminals Division

GENERAL AMERICAN TRANSPORTATION CORPORATION

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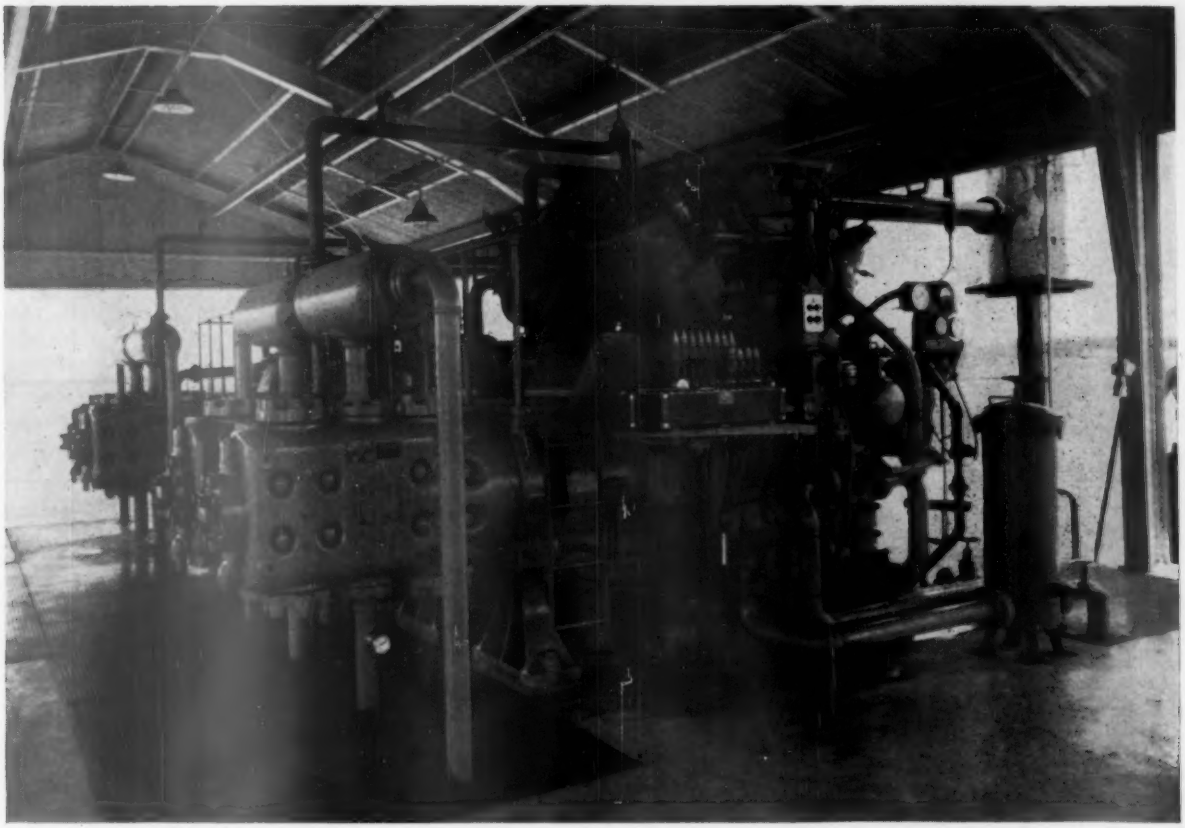
Offices in principal cities

TANK STORAGE TERMINALS GENERAL AMERICAN TRADE MARK

Terminals located at Carteret, N.J.; (Port of New York) Argo, Ill.; (Port of Chicago) Corpus Christi, Texas; Galena Park and Pasadena, Texas; (Port of Houston) Good Hope, La. (Port of New Orleans).



MORE PUMPING TIME, LESS DOWNTIME...

Ambitrol coolants protect against freezing and corrosion

DOUBLE PROTECTION against industrial engine downtime is now available through two new Dow products—Ambitrol* FL and Ambitrol CN coolants. In addition to affording complete freeze protection, Ambitrol offers two methods for combating the widespread problems of local water hardness and corrosiveness.

Ambitrol FL industrial cooling system fluid completely fills the system, requiring no dilution—problems with local water conditions are eliminated. This product is designed to provide freeze protection for industrial cooling systems down to –40° F., with protection against overheating up to a temperature of 240° F.

Since inhibitor depletion can still occur in any cooling system due to extremely severe operating conditions, leakage, etc., Dow provides a further protection with the Dow *Cooling System Maintenance Program.* This is a product analysis service in which periodic samples of the Ambitrol in use are sent to the Dow Industrial Coolants Laboratory. Reports on these samples are returned to the user and contain full information for servicing to maintain both freeze protection and inhibitor effectiveness.

Ambitrol CN is a freeze-depressant concentrate which is blended with local water at the site. Its inhibitor system offers superior protection against damage from corrosion even in the many varieties of water throughout the United States. As with Ambitrol FL, users of Ambitrol CN can participate in the benefits offered by the Dow *Cooling System Maintenance Program.*

Ebullient cooling has solved many of the problems of bigger and more powerful engines, new alloys, and closer tolerances that impose exacting demands for uniform engine temperature control. Ebullient cooling, one system designed to control temperature within a narrow range, is gaining in interest and use. The system calls for chemical compounds radically different from those used in conventional cooling systems. From its continuing research, The Dow Chemical Company developed Dowtherm® 209 coolant to meet these new demands for uniform engine temperature control. Today, Dowtherm 209 is used by many stationary engines having ebullient cooling systems. Its properties offer freeze protection, ideal operating temperatures, and extreme corrosion resistance.

For more information on Ambitrol, Dowtherm 209, or any petroleum industry problem involving chemicals, write directly to THE DOW CHEMICAL COMPANY at Midland, Michigan. *TRADEMARK

THE DOW CHEMICAL COMPANY DOW Midland, Michigan

Improve your Engineering I.Q.*

* INCOME QUOTIENT

Impact a result of contact: Public Speaking not an end, but a vital means to an end

There certainly is no better tool in developing executive or management qualifications than through public speaking. Spoken words are a powerful tool of business. They are used to organize, motivate, coordinate, control, and train.

Since an executive must achieve results through people, he must be able to plan and organize. As a leader, he must be able to motivate and inspire people to action; he must make himself understood. He must have purpose and the will to make other people aid that purpose.

A speaker, too, achieves his results through people. He, too, must be able to plan and organize; must lead; must be able to motivate and inspire others to action; must make himself understood. The speaker must have a purpose and the will to make others aid that purpose. The skills of the executive are identical with those of a speaker, in these areas.

It is not surprising, then, that aspiring leaders in business and industry are judged by their associates and superiors, to a great extent, by their abilities to communicate. It is not surprising that an executive can sell himself, can attain greater authority by broadening his capacities for directing and leading, through oral communication.

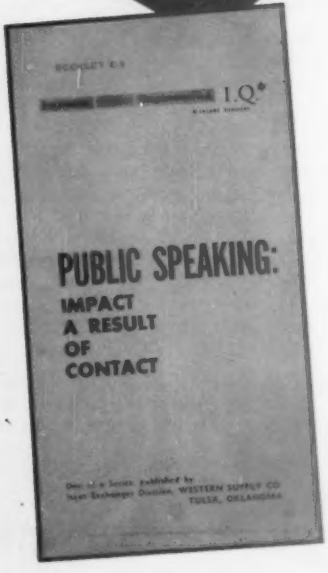
Words have great power, particularly the spoken word. Words give you contact with other men, and if you use them effectively, they give you — *impact*. That impact is multiplied as you develop your ability to speak, and as you speak to more important audiences.

If you are a novice in public speaking you are not alone. No more than 25 per cent of our speakers could qualify as "veterans."

Like conversation, speaking before an audience is based on sincerity and belief. It involves conviction and concern. The public speaker is most convincing when he is least artful, when he is most natural, and above all, when he is sincere.

Effective speaking is not an accident. It is not the special endowment of a few. While talking before many listeners may come naturally for a few, it is, by and large, a learned art. It consists of an idea, phrased simply, and delivered with conviction and with an expressive voice.

WRITE FOR YOUR COPY TODAY



. . . the growth of engineering leadership in the process industry is of great importance to Western, because tomorrow's executives in the petroleum and chemical process fields are our prospective customers . . . Experience in our own organization has taught us the impact of clear and forceful expression of original ideas and solutions to heat transfer problems, and we have thus recognized the importance of learning to speak to audiences of all sizes . . . We've devoted another of Western's "professional development" booklets to this timely subject, and a copy awaits you without obligation . . . Also without obligation, we offer our assistance in the solving of your next heat transfer problem.

WESTERN
HEAT EXCHANGERS
WESTERN SUPPLY COMPANY
P.O. Box 1888 – Tulsa, Oklahoma

ANACONDA Announces

A new high-strength copper-nickel-iron tube alloy that makes possible substantial economies in feedwater heaters

Research metallurgists of Anaconda American Brass Company have developed, after three years of intensive effort, a new high-strength copper-nickel-iron alloy — Cupro Nickel, 30%-707—for heat exchanger tubes in power plant feedwater heaters.

Alloy 707 has mechanical properties comparable with those of a premium high-strength alloy now commonly used, and retains its strength at elevated temperatures—allowing working stresses up to 15,200 psi at 600° F. Thus, in an important area of high-temperature heater application it provides material-cost advantages.

And as these high mechanical properties are for the metal in the *annealed* condition, Alloy 707 tubes can be readily cold worked—can be expanded into tube sheets and formed into tight U-bends.

MECHANICAL PROPERTIES of Cupro Nickel, 30%-707 (nominal composition, copper 64.15%, nickel 30.00%, iron 5.25%, manganese 0.60%) are as follows:

Tensile Strength, min, psi	74,000
Yield Strength, (0.5% Extension under Load), min, psi	36,000
Elongation, % in 2", min	30
Expansion of Tube Inside Diameter with Tapered Pin, %, min	30

STRENGTH AT ELEVATED TEMPERATURES. Extensive tests at room and elevated temperatures show that design stresses given below can be used for Alloy 707:

Maximum Metal Temperature, °F	Maximum Allowable Stress Values in Tension, psi
100	18,300
150	17,800
200	17,500
250	17,100
300	16,800
350	16,400
400	16,100
450	15,900
500	15,600
550	15,400
600	15,200

WELDABILITY. Alloy 707 can be welded by the same methods used for regular 30% cupro nickel.

CORROSION RESISTANCE. Alloy 707 has the same high resistance to stress-corrosion cracking and the same excellent resistance to corrosion by salt water as regular 30% cupro nickel.

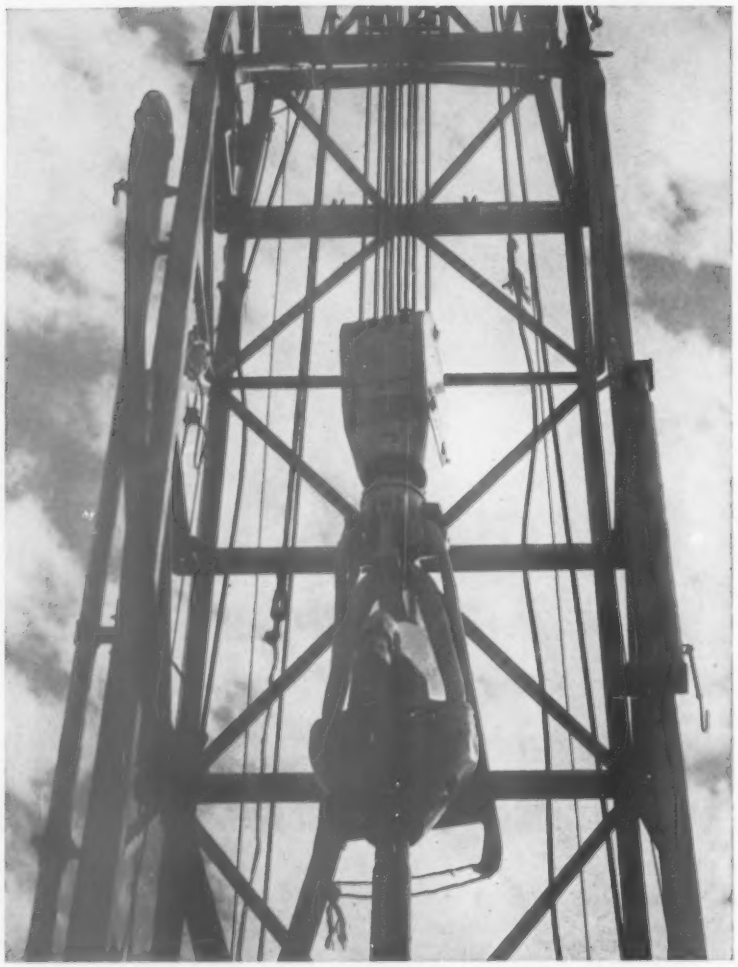
FOR MORE DETAILED INFORMATION on this new high-strength tube alloy, Cupro Nickel, 30%-707, see your Anaconda representative, or write: Anaconda American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont. C3600

ANACONDA®

TUBES AND PLATES FOR CONDENSERS AND HEAT EXCHANGERS

Anaconda American Brass Company

R/M Makes The ONE Rotary Hose For ALL Drilling Methods



Use RAY-MAN CBL ROTARY HOSE with MUD • AIR • GAS • or GAS and MUD

FEATURES

- **Withstands high velocity heated air and gas to 160° F.**
- **Maximum resistance to abrasion from dry drillings during reverse circulation**
- **Resists sand abrasion when used with gas direct from natural wells**
- **High-tensile steel cable-wire reinforcement gives strength plus flexibility to withstand highest pressures**
- **Holds steady in the derrick under deepest drilling conditions—without whipping!**
- **Exclusive built-in coupling eliminates fouling . . . leak-proof "Lip-Lok" tightens under pressure to prevent blowouts!**
- **Features oil-proof neoprene tube**

Now . . . use the best method of drilling depending on hole conditions—and use the *same* Ray-Man CBL Rotary Hose. Changing from oil base mud to air or gas as a circulation medium—or to a combination of gas and mud—presents no problem for Ray-Man Rotary Hose. These built-in engineered features assure long, trouble-free rig performance for *all* drilling service.

Ray-Man's exceptional resistance to accidental crushing and built-in, streamlined couplings make it easier to rig up . . . easier to transport from site to site. Get "More Use per Dollar" with Ray-Man CBL Rotary Hose . . . *the hose* for *all* drilling service. Write for Bulletin M651.

RM 129

RAYBESTOS-MANHATTAN, INC.
MANHATTAN RUBBER DIVISION • PASSAIC, N. J.
ENGINEERED RUBBER PRODUCTS

Professional Guidance Is Your Best Assurance of Success

With some luck, a lot of bass, and plenty of time, who needs a guide? And with twenty producing days a month, 3½ per cent money, and a quick payout, it was a lot easier to get ahead in the oil business. But, when you find that conditions aren't as you would have chosen, whether it's because only a few bass are hiding in the lake or because of drastically cut allowances, the time has come to call in the pros.

The Oil and Gas Loan Department of The National Bank of Commerce is ready to help you now. There are many ways to help, and lending money is only one function of this department. The Oil and Gas specialists in this department have already helped so many others. They've helped them back on the road to a profitable operation by helping them tighten their organization, cut costs by paring fat and not muscle.

The time may well have come when you must start living under the new conditions in the oil business. There's no better way to get started than by beginning to work with the Oil and Gas Loan Department of The National Bank of Commerce.

The oil and gas business is going to be around for a long time to come. Our experience and knowledge of all business can help you to get over the next few years, can help you to keep your organization intact and in good shape. Knowing the oil and gas business is one more reason so many leading independents are with us now. They need the best in banking, and the best in banking costs no more.

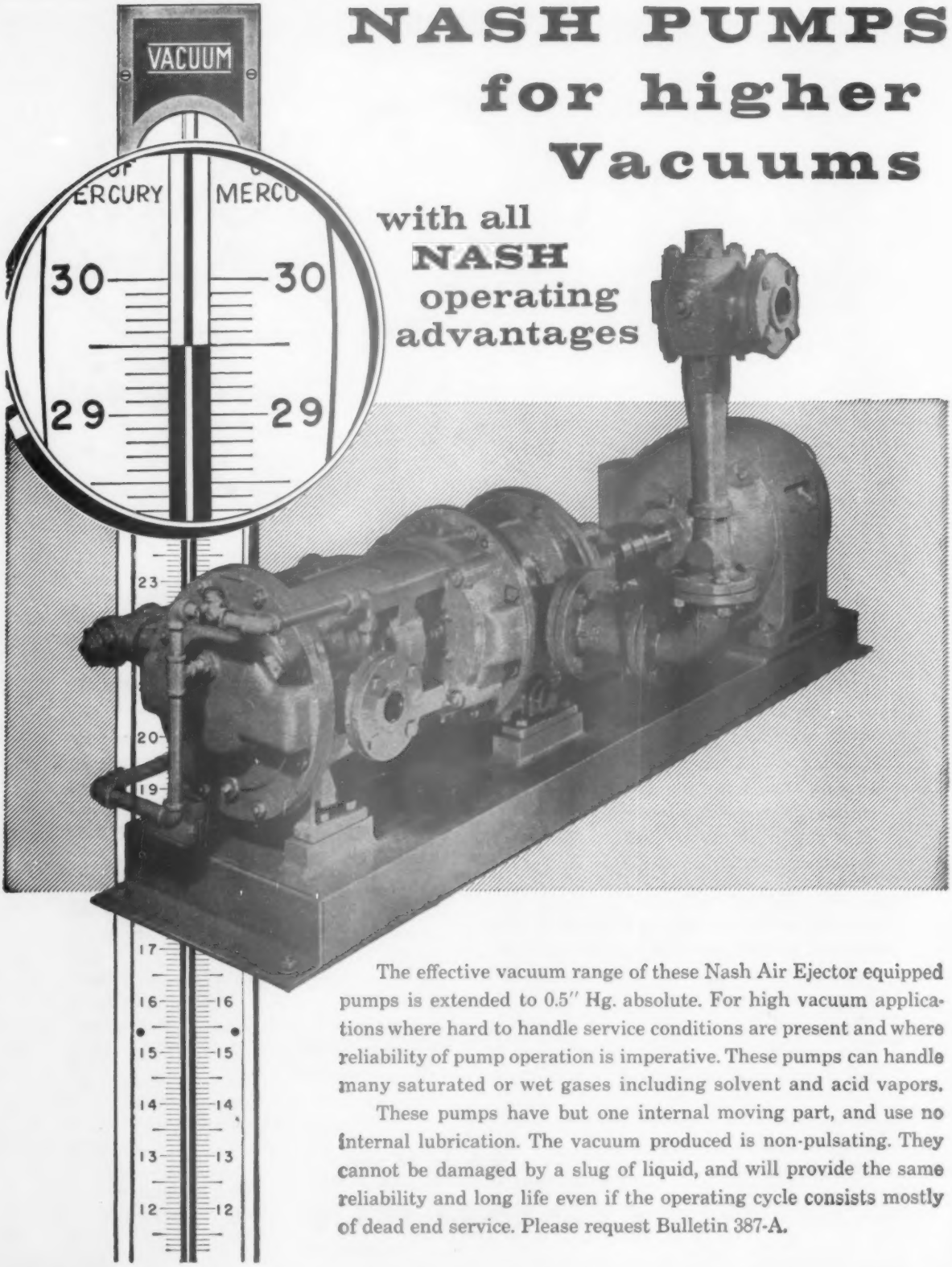
THE NATIONAL **BANK** OF
COMMERCE
OF HOUSTON

MAIN, TRAVIS AND CAPITOL

MEMBER FEDERAL DEPOSIT INSURANCE CORPORATION

NASH PUMPS for higher Vacuums

with all **NASH** operating advantages



The effective vacuum range of these Nash Air Ejector equipped pumps is extended to 0.5″ Hg. absolute. For high vacuum applications where hard to handle service conditions are present and where reliability of pump operation is imperative. These pumps can handle many saturated or wet gases including solvent and acid vapors.

These pumps have but one internal moving part, and use no internal lubrication. The vacuum produced is non-pulsating. They cannot be damaged by a slug of liquid, and will provide the same reliability and long life even if the operating cycle consists mostly of dead end service. Please request Bulletin 387-A.

NASH ENGINEERING COMPANY

SOUTH NORWALK, CONNECTICUT, U. S. A.

6" TO 36"

What Size Line Pipe Do YOU Need?

Armco Line Pipe can meet your requirements. A wide range of diameters (6″ to 36″) combines with wall thicknesses from .109 to .500 to give you the **exact** combinations you need. You don't pay for **excess** steel.

strength, economy, versatility

You're sure to get the strength you want with Armco Line Pipe. Tests prove that the maximum residual stress in Armco Pipe is about 90 per cent less than in many commonly used pipes.

Let us talk with you about **your** pipe line requirements. Just mail the handy coupon.

Armco Drainage & Metal Products, Inc.
4931 Curtis Street, Middletown, Ohio

☐ Have an Armco Sales Engineer call me for an appointment.

NAME_____

ADDRESS_____

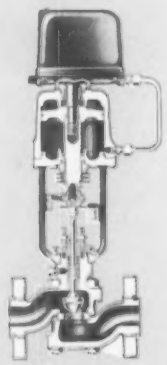
CITY_____

STATE_____

ARMCO Drainage & Metal Products

Compact...Powerful...

FISHER
SERIES
470 P.O.P.
PNEUMATICALLY OPERATED PISTON



SPLIT BODY CONSTRUCTION

Type 470-Z Actuator with a Split body. P.O.P. is also ideal for three way bodies and large single port globe or angle bodies. Only Fisher gives you such a wide selection of actuator-body combinations.

Piston Actuator for Control Valves

does jobs that once required giant size equipment!

POWER—Thrusts up to 17,500 pounds available. Delivers same power in either direction at any point of the stroke.

ACCURACY—Maximum Hysteresis 0.15% of stroke or signal. Repeatability 0.03% of stroke or signal. Resolution Sensitivity 0.02% of instrument signal.

SPEED—4 inches per second stroking speed with the Size 30. Size 60 provides 1.5 inches per second.

STABILITY—Built-in intermediate feedback causes proportional band of positioner to be broad while instrument changes are taking place, yet narrow when unit is not in motion.

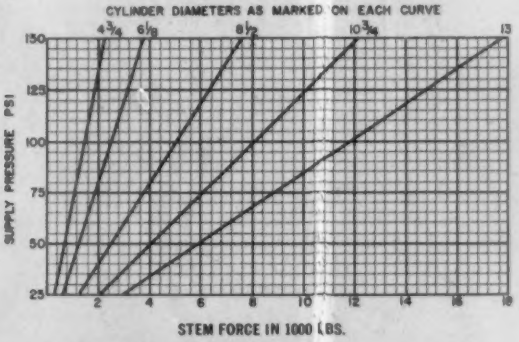
Here's power plus in a small package! This compact Fisher 470 Series has its own positioner mounted integrally on top of the cylinder. Positioner receives any of the normally used pneumatic instrument signals. Then, without an air set, actuator utilizes the full potential of the available air or gas supply (up to 150 psi) to provide exceptional speed and power.

Series 470 is adaptable to virtually all types of valve bodies including butterfly valves. Easily reversible actuator can be changed in the field. Available in six basic sizes and can be supplied for travel up to 4". Basic actuator can also be furnished with a handjack, hydraulic snubber, pneumatic safety devices or as a spring return unit . . . **Write for Bulletin E470.**

BRACKET MOUNTED SERIES 480 P.O.P.

The versatility of Fisher's P.O.P. actuators is further highlighted in the bracket mounted Series 480. The Series 480 provides a compact, powerful actuator for the operation of butterfly valves, louvers, large rheostats and similar equipment found in many industrial applications.

AVAILABLE STEM FORCE



Besides the five basic sizes shown by the curves, a 17 inch cylinder can be supplied to provide thrusts of 12,000 pounds with a supply pressure of only 60 psi.

SPRING RETURN ACTUATOR

Type 473 Actuator with spring safety device. In event of a supply pressure failure control valve will move into the closed position. Also available with spring for return to open position in event of plant air failure.

IF IT FLOWS THROUGH PIPE ANYWHERE IN THE WORLD . . . CHANCES ARE IT'S CONTROLLED BY . . .

FISHER GOVERNOR COMPANY

Marshalltown, Iowa / Woodstock, Ontario / Rochester, England

BUTTERFLY VALVE DIVISION: CONTINENTAL EQUIPMENT COMPANY, CORAOPOLIS, PA.

FISHER® Controls

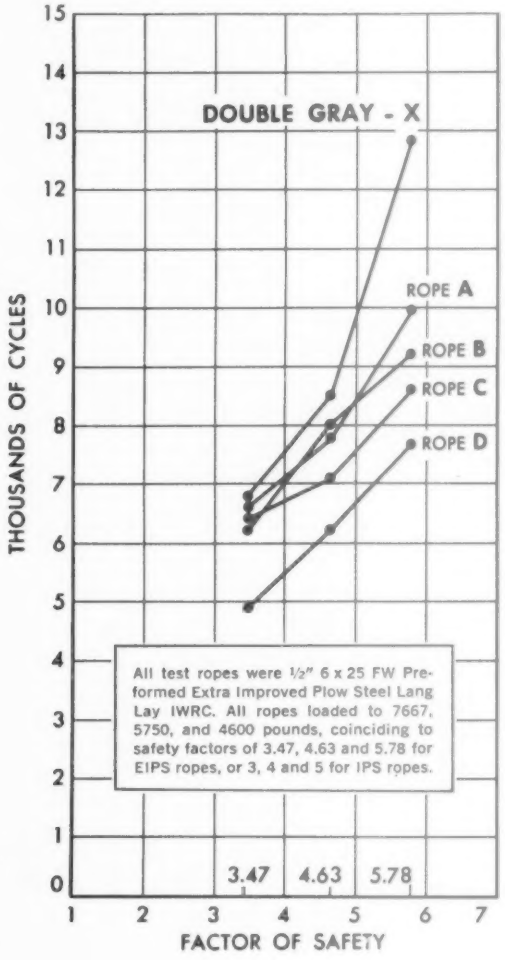
SINCE 1880

DOUBLE GRAY-X® lasts longer

Tests prove CF&I-Wickwire's premium wire rope has 45%* more bending life than average of other ropes tested

In an extended series of tests conducted at CF&I's Palmer Plant, five brands of wire rope were tested to destruction on a 25,000-pound fatigue machine that bends wire rope back and forth over sheaves until it breaks.

All the ropes tested were made by major manufacturers, and were identical in size and specification. And all exceeded the catalog-breaking strength of extra-improved plow steel rope. But, as the chart indicates, one rope outlasted all the others at every safety factor used in the test. That rope was Double Gray-X!


DOUBLE GRAY - X
ROPE A
ROPE B
ROPE C
ROPE D
THOUSANDS OF CYCLES
FACTOR OF SAFETY
3.47
4.63
5.78
All test ropes were ½" 6 x 25 FW Preformed Extra Improved Plow Steel Lang Lay IWRC. All ropes loaded to 7667, 5750, and 4600 pounds, coinciding to safety factors of 3.47, 4.63 and 5.78 for EIPS ropes, or 3, 4 and 5 for IPS ropes.

At the highest and most commonly-used safety factor, CF&I-Wickwire's premium wire rope lasted 30% longer than the rope that survived next longest, and 68% longer than the rope that lasted the shortest length of time. Double Gray-X lasted 45% longer than the average of all other ropes tested at this safety factor.

Double Gray-X has greater resistance to bending fatigue, the chief enemy of wire rope life, because it is the result of a breakthrough in wire-drawing technology. The use of molybdenum disulphide in the drawing process produces these outstanding fatigue-resistance factors:

- A Molecular Shield . . . which prevents the wires from grinding together as the rope operates.
- Smoother Wire Surfaces . . . providing better resistance to fatigue.
- Extra Toughness . . . because molybdenum disulphide helps preserve the inherent toughness of the wire during drawing.

Double Gray-X can save you money because it lasts longer on even the most punishing jobs, as proved by these tests and by field reports from satisfied users. This longer-lasting wire rope cuts repair and replacement costs, lowers your total wire rope investment and reduces machine downtime. Use the wire rope of *tomorrow* today! Ask your CF&I salesman for complete details.

*Percentage above average of all other wire ropes tested at safety factor of 5.78.

The Colorado Fuel and Iron Corporation

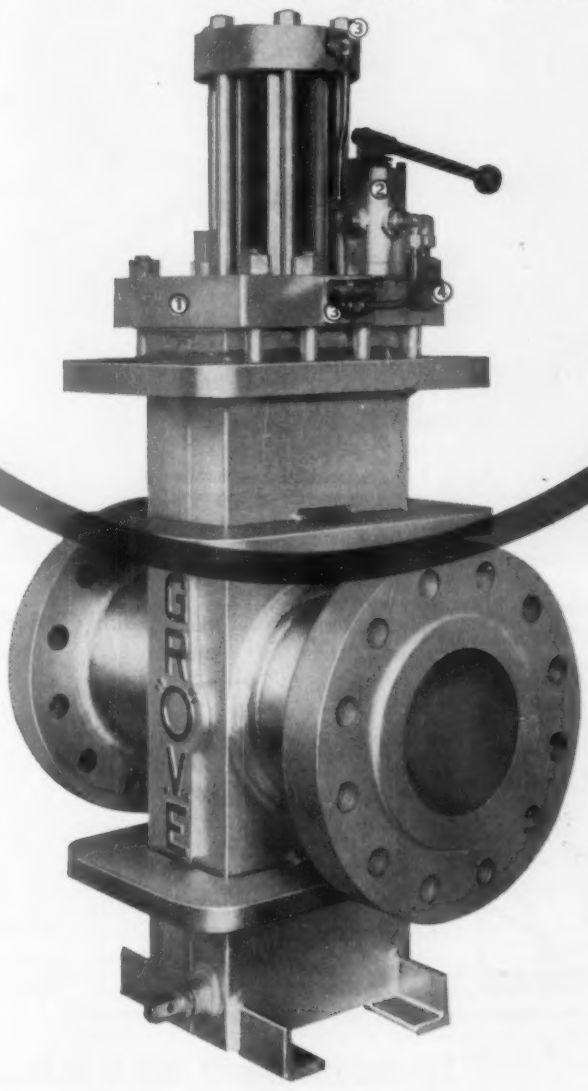
Denver • Oakland • New York
Sales Offices in All Key Cities

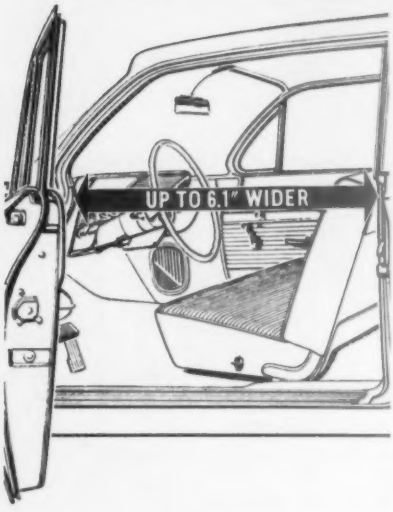
6162

NEW! A GROVE CYLINDER OPERATOR FOR GROVE G-4 VALVES

Now from one source, Seal-"O"-Ring® gate valves with an extremely compact cylinder operator. With fewer parts than conventional units, the operator's reduced size is achieved through designing the valve stem to act also as a piston rod, bringing the cylinder very close to the valve bonnet (1). In some sizes, the valve bonnet actually becomes the lower cylinder head of the operator. The operator comes equipped with a specially designed four-way valve (2) which controls the cylinder. Utilizing line pressure, fluid is applied to either end (3) moving the piston and gate to the open or closed position. A variable orifice (4) in the discharge controls operating speed. Designed for general pipeline service, where ease of operation and/or remote control is necessary.

GROVE PIPELINE VALVES **GROVE VALVE and REGULATOR COMPANY**
a subsidiary of Walworth
6529 Hollis Street, Oakland 8, California
Offices throughout the U.S. and in Western Canada





■ Here's the car that measures up to your fleet needs like no other. Everywhere you look—from those wider, easier-to-get-into door openings to the cavernous new deep-well trunk—you'll find wide-open spaces where you want them. We've even raised the seats and increased the front seat leg room to give you the kind of easy-going comfort that takes fatigue out of long business trips. But with all this extra roominess, Chevrolet's sensible new outside dimensions allow extra inches of clearance for easier parking and garaging. These are just a few of Chevrolet's important new improvements in functional design which further assure you the high trade-in Chevy has always been so famous for. Get in touch with your dealer soon and let him show you all the made-to-order fleet car benefits that make Chevrolet your best investment for economical transportation. . . . Chevrolet Division of General Motors, Detroit 2, Michigan.

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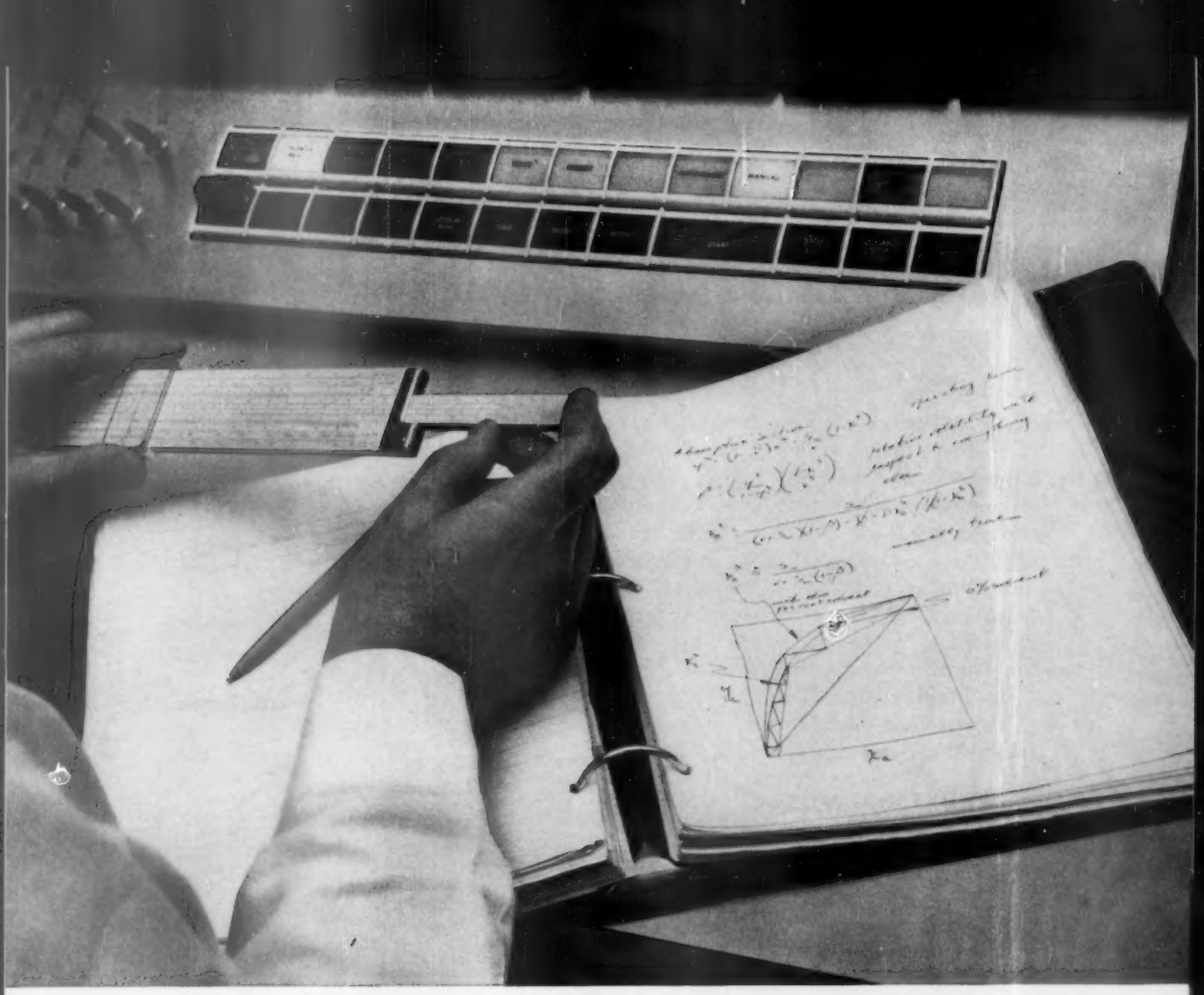

Solve vapor-liquid equilibrium problems quickly, easily with the new low-cost IBM 1620

You can now perform unit operations calculations in minutes with IBM's new Unit Operations Simulator for the 1620. The Simulator consists of 13 automatically available sub-routines*. These are short programs stored in the machine which can be called on to solve your vapor-liquid equilibrium problems.

Included also is an interpreter which allows you to link together the sub-routines you want to use for the problem you are working on at the moment. The *language* of the interpreter is symbolic. This makes it easy to use and eliminates the need to write a detailed program in machine language.

The Unit Operations Simulator is available free of charge to all users of IBM 1620 Data Processing Systems. A basic 1620 rents for just $1,600 a month. Ask your local IBM representative to give you complete details on this versatile, low-cost engineering computer.

IBM's 1620 is a compact desk-size computer.

*Here's what the Unit Operations Simulator does for you: **1.** Computation of (equilibrium constant). **2.** Computation of (temperature) from a given equilibrium constant. **3.** Computation of enthalpy of a vapor and/or liquid stream. **4.** Find equilibrium constant nearest unity. **5.** Computation of temperature from a given enthalpy of a vapor and/or liquid stream. **6.** Bubble point and dew point calculations. **7.** Split one stream into two at specified ratio. **8.** Mix two streams of same phase. **9.** A mixed feed adiabatic flash calculation. **10.** Adiabatic flash. **11.** Isothermal flash. **12.** Flash to a specified quantity of vapor. **13.** Absorber/stripper calculation using Edmister short cut.

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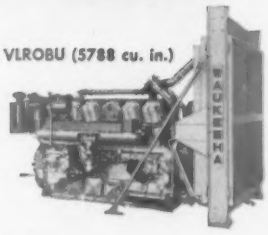
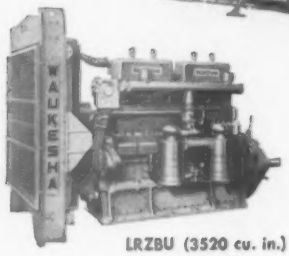


VLROBU (5788 cu. in.)



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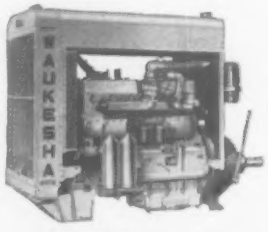
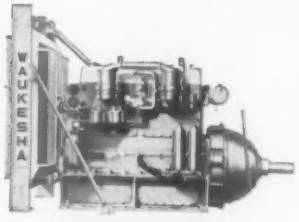


WAKCU (1197 cu. in.)



NKRBU (1905 cu. in.)

496-R-1

The ratings below are for standard engines without power consuming accessories

MEDIUM NATURAL GAS ENGINES					800	1000	1200	1400	1600	1800	2000	2200	2400	2600
MODEL	Features*	Bore & S.	Displ.	Torque–rpm	BRAKE HORSEPOWER AT SPEEDS INDICATED									
ICK	4-A	2½x3⅛	61	36-1600	5	6	8	9	11	12	14	15	16	
FC	4-Ir	3¼x4	133	88-1200	12	16	20	23	26	28	30	31	31	31
180-GKB	4-AC	3⅜x3⅜	155	112-1400	15	20	25	30	34	37	39	42	43	
XAH	4-Ir	3⅜x4½	186	120-1400	16	22	27	32	36	39	42	42		
190-GLB	6-A	3¾x4	265	192-1200	29	36	44	50	57	62	66	67	67	
195-GL	6-A	4 x4	302	214-1200	32	40	49	57	63	68	72	75	76	
195-GK	6-A	4⅛x4	320	217-1400	32	40	49	58	66	74	80	87	93	
135-GZ	6-A	4⅜x5	451	315-1200	48	60	72	83	93	103	112	118	122	
135-GZ	6-AV	4⅜x5	451	315-1200	48	60	72	83	93	103	112	118	122	
140-GZ	6-A	4⅜x5½	554	395-1000	60	75	90	104	116	127	136	144	149	
140-GZ	6-AV	4⅜x5½	554	395-1000	60	75	90	104	116	127	136	144	149	
140-GZ	6-AV†	4⅜x5½	554	453-800	69	86	102	117	132	145	157	167	175	
145-GZ	6-A	5⅜x6	817	597-800	91	113	135	155	174	191	205	219	230	
145-GZ	6-AV	5⅜x6	817	597-800	91	113	135	155	174	191	205	219	230	
145-GZ	6-AV†	5⅜x6	817	646-1000	98	123	147	170	193	214	233	249	264	
WAKC	6-AV	6¼x6½	1197	900-800	137	171	204	236	264	283				
WAKC	6-AV†	6¼x6½	1197	1038-800	158	193	226	258	288	315				

LARGE NATURAL GAS ENGINES					600	700	800	900	1000	1100	1200
NKRB	6-ACV	7 x8¼	1905	1505-600	172	197	220	244	266	286	306
NKRB	6-ACV†	7 x8¼	1905	1600-600	183	211	238	265	288	313	334
LRORB	6-ACV	8½x8½	2894	2270-800	252	300	346	385	420	445	464
LRORB	6-ACV†	8½x8½	2894	2341-800	260	310	357	402	443	478	508
LRZB	6-ACV	9⅜x8½	3250	2700-800	305	357	409	450	485	515	537
LRZB	6-ACV†	9⅜x8½	3250	2850-800	322	378	434	486	533	575	610
VLROB	12-ACV	8½x8½	5788	4590-600	524	601	672	743	807	859	890
VLROB	12-ACV†	8½x8½	5788	4985-700	562	665	753	835	911	978	1027

*FEATURES: 4, 6, 12—No. Cylinders; A—Aluminum Pistons; C—Counterbalanced; Ir—Cast Iron Pistons; V—Vibration Dampener.
†Special high compression ratios for higher horsepower and better economy to be fueled with dry methane type gas having a high heat value of 1150 BTU/cu. ft. or less.

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Yellow Strand "POWERSTEEL"

In these days of deeper wells and faster line speeds, it pays to equip your rigs with Yellow Strand "POWERSTEEL" rotary drilling lines. Here's a built-in ruggedness to combat the shock, strain and wear of today's tough drilling . . . giving you maximum ton-mile service. "POWERSTEEL" rotary lines are made from wire having the highest tensile strength and wear resistance of any Broderick & Bascom wire rope. You gain the safety and assurance of high reserve strength, too.

Ask about the Broderick & Bascom "Tailored Cut-Off Plan." It is scientifically designed for each individual rig, and lowers rotary drilling costs by giving longer ton-mile service.

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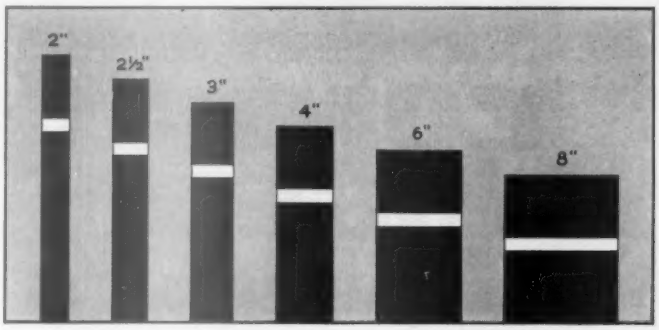
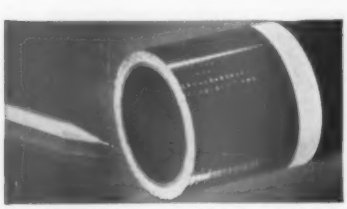


Choose from 6 sizes. Same operating temperature range . . . same operating pressure range . . . same corrosion resistance . . . NEW 6- and 8-inch sizes meet the growing demands of the processing industries.

Now! A complete size range of Fibercast Epoxy Pipe—including new 6″ and 8″

- *handles a temperature range from −65° to 300° F.*
- *withstands an operating pressure range up to 1200 psi.*
- *pipe sizes from 2″ to 8″*

Only Fibercast, with its unique reinforced epoxy resin construction, can withstand sustained high pressures, high temperatures and extreme corrosive conditions more efficiently than any other pipe. Fibercast's ability to competently handle 320 of 338 corrosive solutions is on record. And now Fibercast, in answer to more of the needs of industry, brings its proven value to larger size flow lines.



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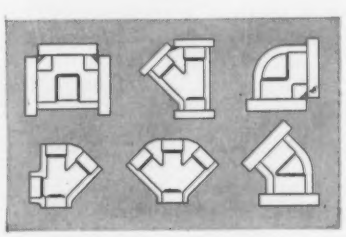
**An additional safety factor is that Fibercast, with its seamless woven glass fiber construction, cannot burst.*

Fibercast Fittings, of course, are also available for the new sizes. They represent the world's most complete stock of standard sizes and types. And, as always, you can have couplings, or even complete piping systems, designed and made to order for your individual requirements.



Get the full story on Fibercast's cost-saving advantages to industry. Learn how it can help *you* solve *your* pipe and tube problems. Mail the coupon today.

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SHORT COMPACT RUGGED

GUIBERSON'S SHORTY TENSION PACKER *for* WATER FLOODING

Here is a rugged, low-cost retrievable tension packer that's short and easy to handle. Uncomplicated and functional in design, it's easy to set, space out and spot . . tension set by pulling on tubing string. And Guiberson's shorty tension packer is priced to cut your costs . . designed especially for water flood injection wells.

SAFETY JOINT COUPLING: right hand release 8 round thread for added safety.
ANCHOR CAGE: one piece malleable iron.
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LATCH: dependable J-slot mechanism, shock-absorber equipped, independent of safety joint operation.
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RUBBER: specially compounded to withstand the most rugged oilfield use at high pressures and temperatures—built-in ability to return to original shape.
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SAFETY RELEASE NUT: predetermined tension load at packer strips out, leaving safety nut, thimble, rubber and head—all drillable.

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Gate, Globe and Check VALVES

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FORGED STEEL

VALVES

They Say—

They like Phillips' policy

Dear Sir:

Congratulations to you on your fine interview with E. H. Lyon, vice president of Phillips Petroleum Co., and for the clarity with which you have explained the new Phillips pricing policy (OGJ, Feb. 27, p. 60).

I feel that this policy is one that is correcting a pricing philosophy which is outmoded and which had become destructive.

From your article the basis of the new policy seems to be one that will endeavor to assure the refiner a fair price for his commodities and offer to the jobber the same opportunity to obtain a fair profit.

At the same time, if the jobber does not act in a businesslike way to maintain this profit, then the burden is not passed on to the refiner.

Recently another major refiner has put in a new marketing policy basing his price on only 1 cent over the independent price, thus reducing the traditional 2 cent differential to 1 cent. This method takes no cognizance of the major's cost of doing business, prestige or local advertising, the high cost of credit cards and credit losses, radio, television or all of the other marketing costs of so called "prestige" operations.

Such a policy, whether the differential is 1 cent or 2 cents, is the very policy that has led to ruinous price wars where the big refiner has stood the entire cost.

We like Mr. Lyon's thinking and the results he has obtained from his experiments.

M. Lloyd Freese
Vice President
Bell Oil & Gas Co.

More road mileage possible

Dear Sir:

I have expectantly awaited realization by the oil industry that the easiest and most pleasant route to relief from its recurrent problem of excess production or runs is a rapidly expanding market.

the OIL AND GAS JOURNAL

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Evidence of such thinking on a widespread basis has now appeared. But, in my opinion, emphasis is still not being placed on the quickest and easiest palliative, namely, to get more road mileage from the tremendous sums now being collected for highway construction. In desperation I have written the attached comment in the hope that you may consider it usable as a guest editorial.

I believe I can speak on these matters with some authority. For some 40 years I have been associated with the oil business in a number of aspects. For the last 10 years I have been a consultant. I am a contributing editor of Roads and Streets magazine.

Henry G. Nevitt
Kansas City

Mr. Nevitt's editorial follows—Ed.

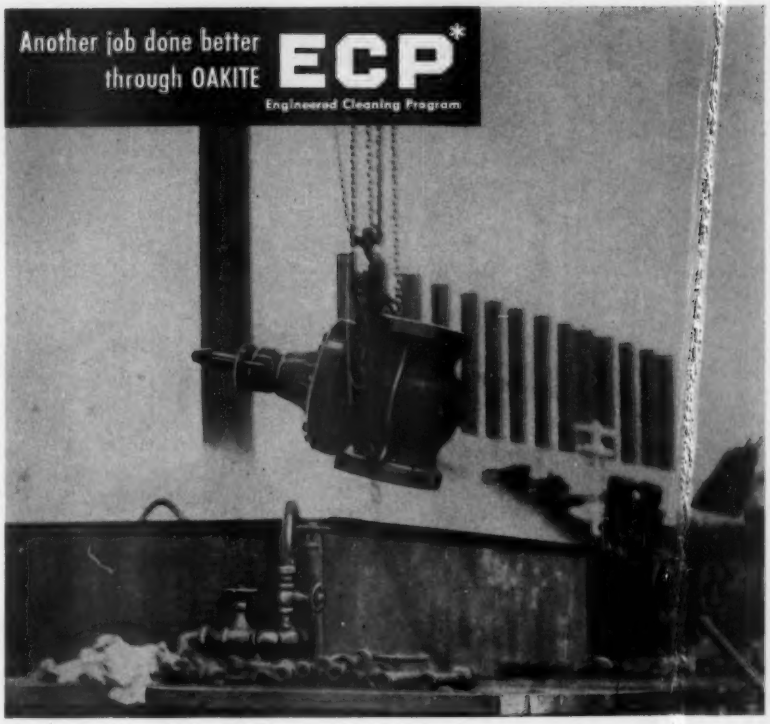
First things first

The petroleum industry has finally decided that it should actively proceed to augment the market for its principal products—gasoline and lubricating oil. The only thing surprising about this conclusion is its late date. Most sellers of materials take it for granted that enlargement of the market is an important part of their business.

Preliminary studies indicate the public can be conditioned to want to drive more. But we do not think this is the real problem. The principal need is to make this additional driving both possible and pleasant.

In our urban areas and in the more industrialized sections of the country, driving for pleasure, at the times most people can and wish to do so, is no longer possible. A trip to the country for sightseeing is devoted mostly to long periods of bumper to bumper traffic in an atmosphere of car fumes. More roads are an essential prerequisite to more driving.

This phase of the problem has been neglected by the industry. Yet the industry has a helpful aid to this problem in its own hands. If its own product, asphalt, were more generally as well as wisely used, a greater mileage of roads could be had for the present available funds. And closer interest in highway developments could lead to further



Parts salvage becomes big source of savings

Salvage cleaning of flanges, fittings, valves and other parts formerly took up to 22 hours a batch at one refinery. Heavy deposits of grease, paint, oil and rust were being stripped with a cold solvent. The effort seemed hardly worthwhile.

But in developing an ECP for the refinery, the Oakite engineer included a recommendation to install a permanent salvage cleaning setup. It paid off. Parts reclamation became a strong contributor to cost control . . . with work moving, as if in a "production line," through special Oakite solutions. Stripping even the worst of soiled batches to bare metal now takes only an hour and a half . . . while material costs have been cut from $1.90 a gallon to less than 58 cents!

Proving once again that an Oakite Engineered Cleaning Program is not only scientifically sound but also *economically* valuable.

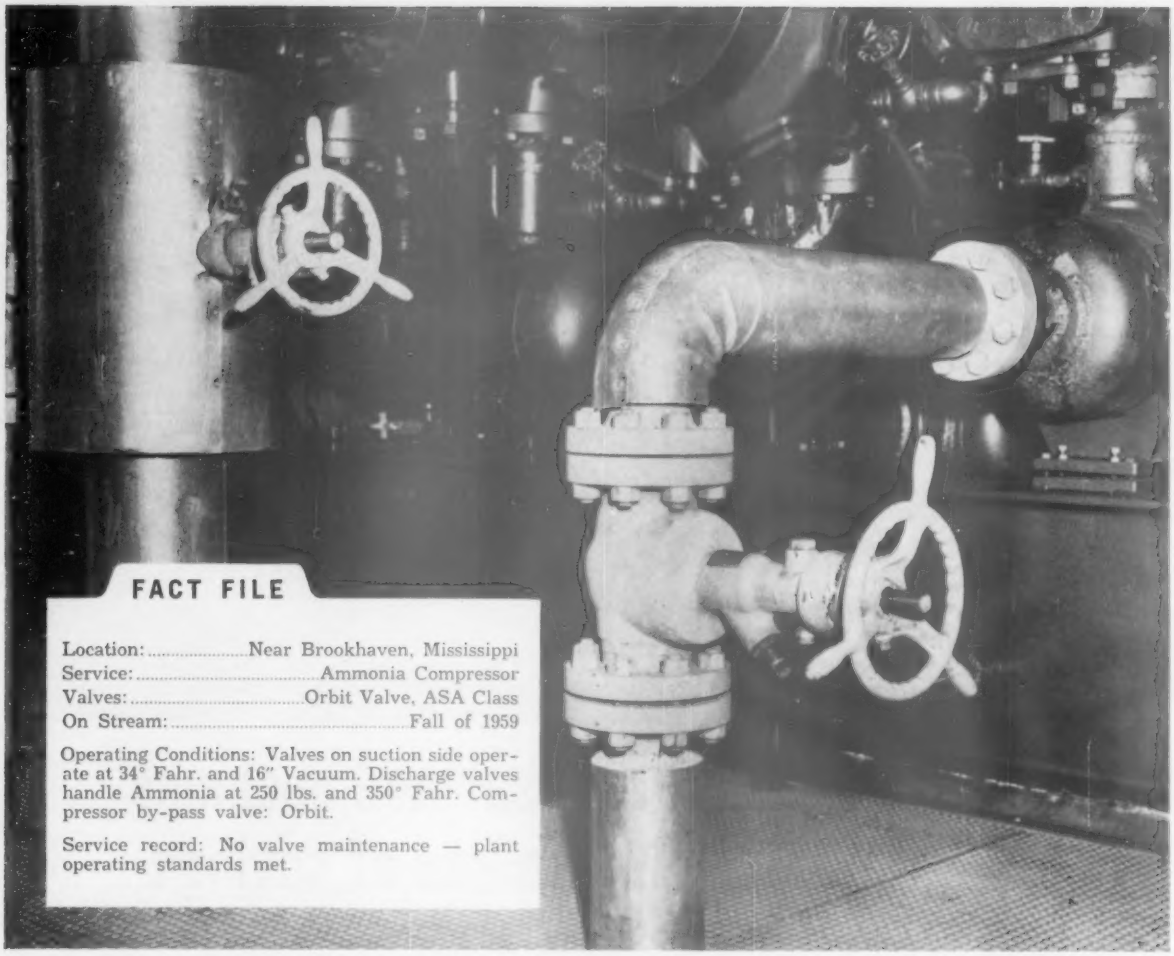
*Oakite ECP is a comprehensive cleaning program engineered to fit your particular operation under the experienced supervision of a local Oakite man. ECP covers every cleaning need. For details, write Oakite Products, Inc., 44C Rector Street, New York 6, N. Y.

OAKITE
over 50 Est. 1909 SCIENCE
years' leadership in industrial cleaning

OAKITE ECP benefits you from the ground up . . .

at drilling site it speeds such salvage operations as paint stripping, rust removal, degreasing

it restores pipeline efficiency through chemical cleaning... it simplifies pump station housekeeping



FACT FILE

Location: ..... Near Brookhaven, Mississippi
Service: ..... Ammonia Compressor
Valves: ..... Orbit Valve, ASA Class
On Stream: ..... Fall of 1959

Operating Conditions: Valves on suction side operate at 34° Fahr. and 16" Vacuum. Discharge valves handle Ammonia at 250 lbs. and 350° Fahr. Compressor by-pass valve: Orbit.

Service record: No valve maintenance — plant operating standards met.

where valve specifications demand NO LEAKS/NO LUBRICANTS

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Henry G. Nevitt, Kansas City.

Letters to They Say should be addressed to The Editor, The Oil and Gas Journal, Box 1260, Tulsa, Okla.

CALENDAR

MARCH

20 American Gas Association, general management section conference, Francis Marion Hotel, Charleston, S. C.

21-23 American Power Conference, twenty-third meeting, Sherman Hotel, Chicago.

21-30 American Chemical Society, 139th annual meeting, Kiel Auditorium, St. Louis.

22 American Institute of Chemical Engineers, Chicago section, symposium on new developments for chemical processing and new developments for the engineer and management, Conrad Hilton Hotel, Chicago.

22-24 American Petroleum Institute, Division of Production, southwestern district meeting, Cole Hotel, Albuquerque.

23 National Industrial Conference Board, general session, Shamrock-Hilton Hotel, Houston.

23-24 North Texas Oil and Gas Association, annual meeting, Kemp Hotel, Wichita Falls, Tex.

27-28 University of Wichita, School of Engineering, third annual production institute, university campus, Wichita.

28 Canadian Petroleum Association, annual general meeting, Hotel Palliser, Calgary.

27-29 Midwest Gas Association, annual meeting and convention, Sheraton-Fontenelle Hotel, Omaha.

27-29 Society of Petroleum Engineers of AIME, Saudi Arabia section, regional meeting, Dhahran, Saudi Arabia.

27-31 Instrument Society of America, symposium on temperature measurement and control in science and industry, Veterans Memorial Auditorium, Columbus, Ohio.

28-29 University of Oklahoma, Schools of Petroleum and Gas Engineering, gas conditioning short course, Oklahoma Memorial Union Building, University of Oklahoma, Norman.

APRIL

4 Instrument Society of America, New Jersey section, annual symposium on electronic process instrumentation, Hotel Essex House, Newark, N. J.

4-5 University of Kansas, gas compressor Institute, Liberal, Kans.

5-6 Third annual symposium on pilot plant and process automation, Ambassador Hotel, Los Angeles.

5-7 American Petroleum Institute, Division of Production, Mid-Continent district meeting, Mayo Hotel, Tulsa.

6-7 University of Oklahoma, School of Mechanical Engineering, short course on industrial engines, University of Oklahoma, Norman.

6-8 Texas Oil Jobbers Association, Petroleum Marketers Association, convention and trade show, Baker Hotel, Dallas.

8-12 Petroleum Equipment Suppliers Association, annual meeting, The Greenbrier, White Sulphur Springs, W. Va.

10-11 American Society of Mechanical Engineers, maintenance and plant engineering conference, Bancroft Hotel, Worcester, Mass.

10-12 Western Petroleum Refiners Association, annual meeting, Granada Hotel, San Antonio, Tex.

10-13 American Society of Mechanical Engineers, oil and gas power conference and exhibit, Jung Hotel, New Orleans.

11-13 Petroleum Industry Electrical Association and Petroleum Electric Supply Association, annual conference, Moody Convention Center, Galveston, Tex.

12-14 Investment Bankers Association of America, annual convention of the Texas group, Shamrock Hilton Hotel, Houston.

14 American Institute of Chemical Engineers, St. Louis section, third

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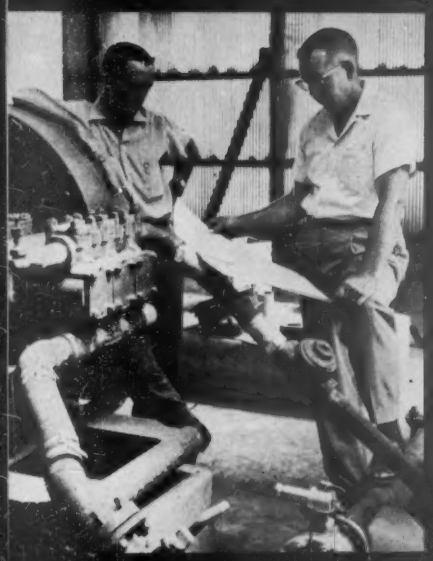

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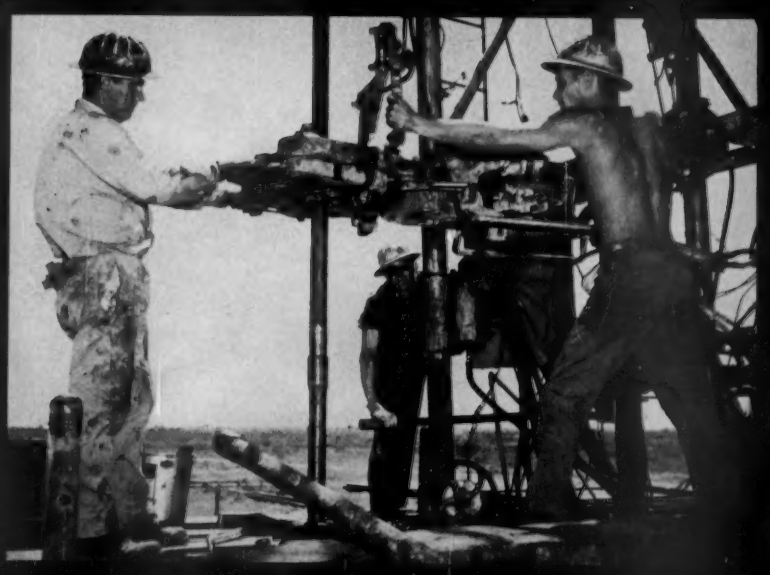

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Jones & Laughlin Supply Division—Tulsa

annual symposium, Coronado Hotel, St. Louis.

17-19 Instrument Society of America, symposium on instrumental methods of analysis, Shamrock-Hilton Hotel, Houston.

18-20 University of Oklahoma, southwestern gas measurement short course, North Campus, University of Oklahoma, Norman.

19-20 University of Tulsa, fifteenth annual conference of accountants, University campus, Tulsa.

19-20 National Petroleum Association, semiannual meeting, Hotel Sheraton-Cleveland, Cleveland.

20-21 Society of Petroleum Engineers of AIME, East Texas-Louisiana-Arkansas gas-technology symposium, Tyler, Tex.

20-21 Texas Technological College, annual West Texas oil lifting short course, Lubbock, Tex.

20-22 Illinois Society of Professional Engineers, annual convention, Peoria, Ill.

24-26 Southern Gas Association, meeting, New Orleans.

24-27 American Association of Petroleum Geologists, Society of Economic Paleontologists, and Rocky Mountain section of AAPG, annual meeting, Denver Hilton Hotel, Denver.

26-28 American Petroleum Institute, Division of Transportation, pipeline conference, Chase-Park Plaza Hotel, St. Louis.

27-28 Rocky Mountain Oil and Gas Association, midyear meeting, Northern Hotel, Billings, Mont.

28 Natural Gasoline Association of America, Oklahoma regional meeting, Lake Murray Lodge, Ardmore, Okla.

29 American Institute of Chemical Engineers, Oklahoma state meeting, University of Tulsa, Tulsa.

30-May 2 Independent Petroleum Association of America, midyear meeting, Roosevelt Hotel, New Orleans.

30-May 3 Liquefied Petroleum Gas Association, convention and trade show, Conrad Hilton Hotel, Chicago.

MAY

2-4 Purdue University, School of Civil Engineering, sixteenth industrial-waste conference, Purdue Memorial Center, Lafayette, La.

3-5 American Petroleum Institute, Division of Production, Rocky Mountain district meeting, Gladstone-Henning Hotel, Casper, Wyo.

4-5 Society of Petroleum Engineers of AIME, oil recovery conference, Midland, Tex.

4-5 Pacific Coast Gas Association, Inc., transmission conference, Biltmore Hotel, Santa Barbara, Calif.

4-5 Illinois State Geological Survey, Illinois Basin chapter of AIME's Society of Petroleum Engineers, biennial petroleum engineering conference, University of Illinois campus, Urbana.

5-7 Indiana Geological Survey, Indiana Department of Conservation, University of Indiana department of geology, tenth geologic field conference, stratigraphy of the Silurian rocks of northern Indiana, Marion, Ind.

7-10 American Institute of Chemical Engineers meeting, Sheraton-Cleveland Hotel, Cleveland.

8-11 American Petroleum Institute, Division of Refining, midyear meeting, Rice Hotel, Houston.

8-12 American Gas Association, distribution and production conference, Sheraton Hotel, Philadelphia.

9-11 Western Joint Computer Conference and Exhibit, Ambassador Hotel, Los Angeles.

10-12 American Society of Mechanical Engineers, production engineering conference, Royal York Hotel, Toronto.

10-12 Canadian Institute of Mining and Metallurgy, oil and gas division, and Calgary and Edmonton petroleum engineering sections of Canadian Institute of Mining and Metallurgy and American Institute of Mining, Metallurgical, and Petroleum Engineers, annual meeting, McDonald Hotel, Edmonton, Alta.

11-12 American Petroleum Institute, Division of Production, Pacific Coast district meeting, Biltmore Hotel, Los Angeles.

11-12 Texas A. & M. College, thirteenth oil recovery conference, College Station, Tex.

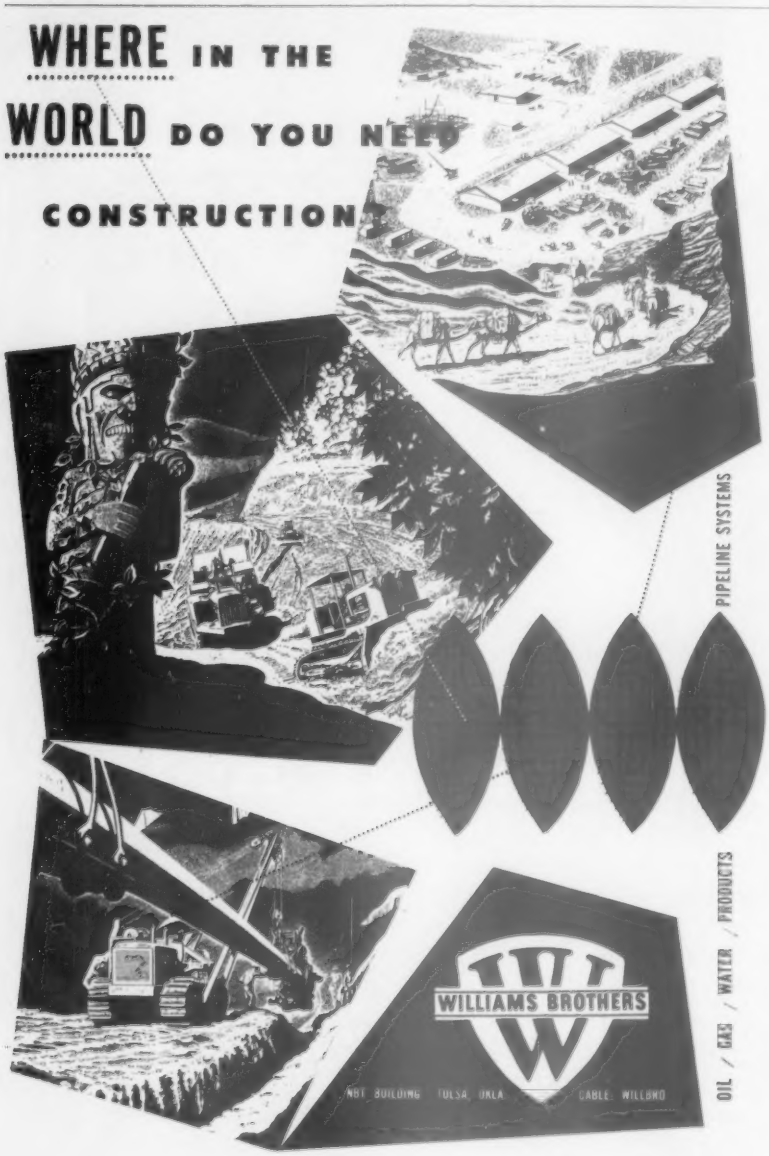
12 Natural Gasoline Association of America, Permian basin regional meeting, Lincoln Hotel, Odessa, Tex.

14-17 Texas Independent Producers and Royalty Owners Association, Scharbauer Hotel, Midland, Tex.

16-19 American Petroleum Institute, Division of Marketing, midyear meeting, Americana Hotel, Miami Beach.

17-19 Western Petroleum Refiners Association, Mid-Continent regional technical-industrial relations meeting, Hotel Lassen, Wichita.

17-19 Society of Professional Well Log Analysts, second annual meeting and logging symposium, Sheraton-Dallas Hotel, Dallas.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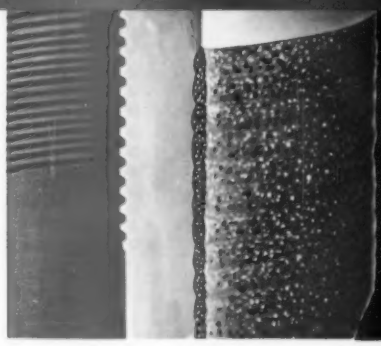

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50 years ago

March 23, 1911

The Belgium Colonial Government authorizes the laying of a 200-mile 4-in. pipeline across the Congo from a bulk tank-steamer terminal at Matadi, on the coast, to a bulk-distributing station at Stanley Pool, 1,000 ft. above sea level. Daily petroleum requirements in the high Congo district are placed at 350 bbl.

Authoritative sources confirm revived reports that T. N. Barnsdall has closed his long-pending deal with a French syndicate for the sale of his properties, except gas holdings, for $15,000,000. Properties area spread over California, Oklahoma, Kansas, Louisiana, Texas, and the middle-western and eastern states.

Ohio gas producers organize Natural Gas Assocation of Ohio with J. M. Garard, vice president of Ohio Fuel Supply Co., Columbus, as its first president. Development of better production methods and prevention of gas waste are chief objectives.

25 years ago

March 19, 1936

New Pearsall field opened by Amerada Petroleum Corp. and Rycade Oil Corp. in Frio County, Southwest Texas, looms as large-scale, multiple-pay producing area. Its 12 wells completed so far stretch the field more than 7 miles without definition in the 85,000-acre block.

Michigan feels refinery-building boom coincident with its new active oil-development play. Construction gets under way at 12 plants, 5 of them new. Thirteen plants with daily crude capacity of 40,000 bbl. are running now. New building, to cost $2,000,000 will add 15,000 bbl. daily.

10 years ago

March 22, 1951

Oklahoma Supreme Court upholds constitutionality of state's compulsory-unitization law after lengthy litigation. Court holds that police power of state extends to correlative rights of owners of oil in the ground.

Iranian legislative body votes unanimously to nationalize oil properties of Anglo-Iranian Oil Co., Ltd. Whether government will carry through to actual seizure of the company is open to speculation.

M. W. Kellogg Co. gets contract for construction of a new 10,000-bbl. refinery for Refinaria de Petroleos do Distrito Federal, S. A., a private Brazilian company, in Rio de Janeiro, Brazil. It will be the third major processing unit for that country.

JOURNALLY SPEAKING

Quasi-Queasy Query

"These seats are reserved for those who are confused," announced one of the oil writers at the press table during the Federal Power Commission's Midland conference on how to go about setting gas prices for the Permian basin area.

Such a sign should have been hung over the entrance to the hall. Everyone, including the presiding examiner, seemed to be just as confused as the writers.

FPC has never set gas prices on an area basis, and hasn't said how it hopes to go about it. Also it had never held a prehearing conference like this one, and hasn't specified how this should be conducted. It asked for suggestions but about all it got were objections—objections to what it has done, or to what it hasn't done, or to what somebody suspected somebody else might try to do.

The examiner kept asking if groups with common interests couldn't get together and agree to put in joint testimony, but one after another the attorneys for individual producers got up and reserved the right to put on their individual cases.

One agent for a family-held group of related companies and trusts asked if he would be considered a group or a bunch of separate entities, and when he failed to get an answer he observed "What we can't understand is why everything has to be so complicated."

That was what nobody else could understand, either. Except maybe the lawyers, who perhaps like to keep things complicated. There were a couple of hundred lawyers present, and none of them made any notable contributions toward simplifying things.

Later we heard one of these lawyers explain the underlying reason for the confusion. The FPC, he said, is a quasi-judicial, quasi legislative, quasi-administrative body. (Quasi means halfway, or sort of.)

In other words, FPC wears three hats. And neither the producers, the consumers, the courts, nor the FPC itself seems to be sure just which hat it is wearing, or ought to be wearing, at any particular moment.

Through most of its efforts to set gas prices, this lawyer continued, FPC has been acting in its quasi-judicial capacity. It has sat back like a judge listening to adversaries argue their claimed rights and then tried to weigh the merits on the basis of the testimony in the record.

This method failed to determine the just and reasonable price for gas. So last September FPC put on its quasi-administrative hat and announced, out of a blue sky, that hereafter it would set prices on an area basis.

But in setting area prices FPC wants to proceed in a quasi-legislative manner. That is, it wants the type of evidence that would be presented to a congressional committee writing a law, rather than the type used in a lawsuit. But everybody has been so conditioned to the adversary type of procedure that nobody, particularly the lawyers, can get out of the old groove, and that's the basic cause of the confusion.

After mulling this over for awhile we concluded that the best adjective for the FPC is not quasi but queasy — meaning ticklish, uncomfortable, or nauseated.

So we posed this query: Suppose FPC should get over its quasi-queasy posture and tighten its belt, pull down a full-sized administrative hat, and go out and make its own determination of what gas ought to sell for without asking anybody's prejudiced opinion—and then rear back and announce that that is the just and reasonable price.

FPC almost did this in setting its area ceilings, but it did it in such a quasi-hearted and queasy-stomached manner that nobody took it seriously. If we must have regulation, there ought to be a point where somebody would say this is it, boys; take it or leave it.

Everybody, including the courts, would be so astonished at this show of guts that maybe FPC could get by with it. Of course this would cause confusion, but what have we got now?

—Henry D. Ralph

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This results from a new design concept that moves the hold-down from the tubing to the packer, placing it below the bypass valve. This restores surface control of the bypass valve for pressure equalization, eliminates button dulling, and provides dependable release of the hold-down.

And, back of the Model "R" is the Baker service organization. Domestically, 62 Baker field-service warehouses stand ready to supply packers, parts and repair service. Ask one of the 400 Baker servicemen to give you the complete story on both the Double-Grip and Single-Grip (no hold-down) versions of the Model "R" Packer.

HERE'S HOW THE NEW DESIGN CONCEPT WORKS...

(1) Note that the *Bypass Area* through the packer is completely isolated from the packer mandrel and tubing. Pressure surges in the tubing cannot dull buttons while running in or retrieving. Solids in tubing fluid cannot compact behind buttons and prevent retraction.

(2) Note that the *Hold-Down* is a part of the packer, not attached to the mandrel... leaving the bypass valve free for instant pressure equalization.

(3) Note that a *Differential Lock* holds the bypass valve closed without requiring high set-down weights... yet can be instantly released by picking up on the tubing.

The new concept in long-stroke packers is fully explained in Bulletin 385. Write: Baker Oil Tools, Inc., P. O. Box 2274 Terminal Annex, Los Angeles 54, California

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Barnacles on oil's ship of progress

TEXAS AND KANSAS are currently experiencing political opposition to joining the "new" oil industry which is rapidly flowering in most other major producing states.

These two states are a generation behind the bulk of the industry in pooling of interests within a drilling unit, and several years behind the vanguard in adjusting allowables to fit the trend toward efficient well spacing.

In spite of repeated warnings that operators will be attracted away to areas with modern conservation practices, highly vocal groups of small producers in both states insist on clinging to ways of doing things which have held over from the horse-and-buggy era.

A TRANSFORMATION tantamount to an industrial revolution has taken place in the producing industry in recent years. But many producers and state regulatory bodies are only dimly aware of it.

This "new" industry puts a premium on efficiency and cost cutting—in leasing, exploration, drilling, field development, and lifting practices. Its most favored and most rewarding device is making one well do the work of several. But in this it is hampered if not thwarted by obsolete regulatory practices in some states.

Efficient development and production require ability to space wells so as to get the optimum recovery with the least investment (as governed by the nature of the reservoir rather than arbitrary rule), plus automatic pooling of mineral rights within the spacing unit, plus an allowable formula that protects correlative rights while fostering economical practices. All three must go together.

Some states, notably in the Rocky Mountain region, have reaped rich rewards from encouraging these enlightened practices. Others, notably Texas and Kansas, persist in inequitable rules which discourage their producers from adopting efficient methods.

A TEXAS COURT has just ruled out an ancient and arbitrary allowables formula as applied to one gas field. It said the disproportionately large production permitted a small-tract well is unreasonable and discriminatory. Also that the archaic rule of capture—long since dead nearly everywhere else—can't be used to block adequate regulatory practices.

This ruling may break the political stalemate in Texas, although adherents of the old order are raising a war chest to fight any change. Similarly last week Kansas producers split into factions over pending legislation to modernize their state's spacing and producing practices.

The more advanced states may chuckle at the troubles of their older sisters in catching up with the parade of progress. But it is a serious concern to the U. S. oil industry as a whole since it involves the efficiency of a large portion of domestic production.

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Here is an ideal vehicle for the rough jobs, out where the roads don't exist. Where the mud, the sand, the ruts can make life impossible for a conventional two-wheel-drive truck of any size. This is the Dodge model W100, one of five rugged Dodge 4 x 4 models that range in capacity from 6,000 lbs. to 20,000 lbs. GVW.

The W100 is powered by a 140 hp. inclined engine, the Dart Power Six. Optional power can be provided by a 200 hp. truck V8. Standard transmission is 3-speed synchromesh, with a 4-speed synchromesh box an optional extra. A 2-speed, 2-lever transfer case with either transmission directs power to the rear axle or to both axles at the driver's option. The model shown here is the Sweptline pickup. Additional body styles on the W100 chassis include a conventional pickup, a panel, and the versatile Town Wagon model, all handy workers on or off the road.

Larger Dodge 4 x 4 models include the W200, W300, W500, and the WM300, the last a familiar vehicle to anyone who served in the armed forces. Except for the WM300, all models are available with optional Six and V8 power, and standard hydraulically-actuated clutch. The WM300's engine is a rugged, dependable 125 hp., 251 cu. in. Six.

Talk trucks with your dependable Dodge Dealer. He'll tell you some interesting things about 1961 Dodge trucks. One is that, model for model, they are priced competitively with any other truck you can name. Another is that Dodge trucks are backed by a new 24-hour-a-day, seven-days-a-week emergency parts operation. Wherever you and your Dodge truck may be, you can be sure of rapid delivery of the parts you need to keep you on the job. SEE YOUR DODGE DEALER.

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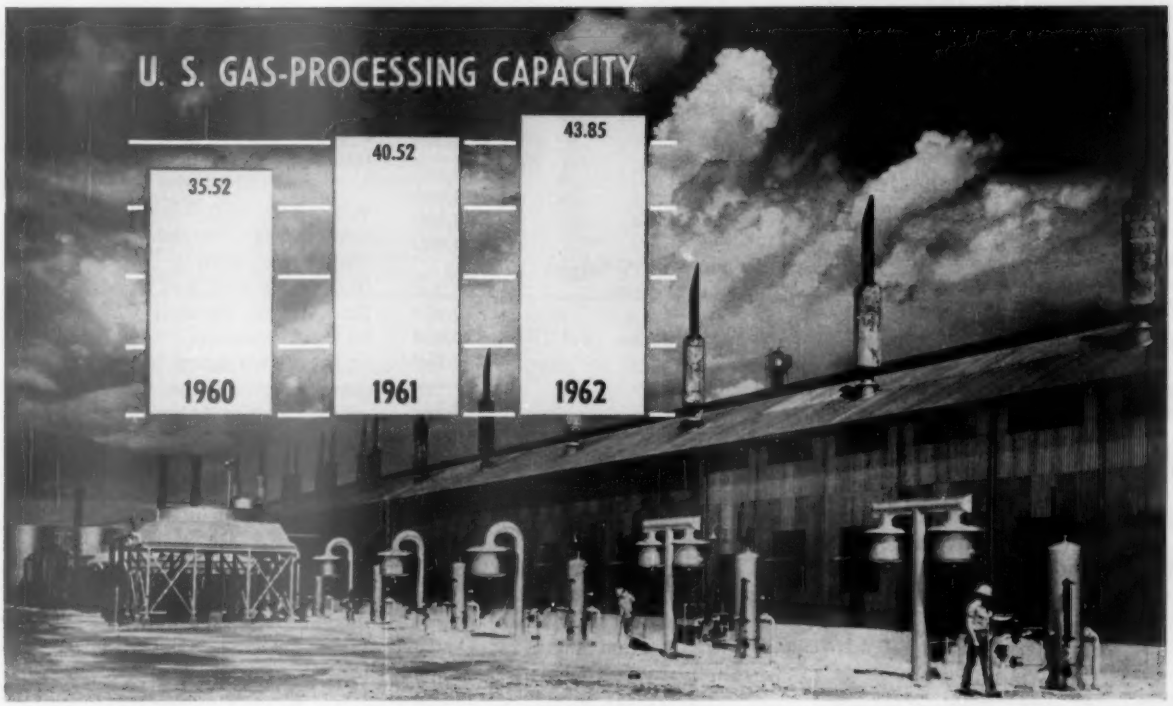


BIG RISE in capacity figures (billion cubic feet daily) and 1962 estimate shows . . .

Gas Processing Still Booming

Hugh Pylant
Petrochemical and Gas
Processing Editor

THE GAS-PROCESSING industry is enjoying a tremendous surge of growth, and indications are this will continue well into 1962.

This boom is statistically measured by:

. . . **New plants.** There were 80 new plants or expansion programs started in 1960, and 45 are under way this year.

. . . **Plant capacity.** The impact of new construction shot capacity from 35.52 billion cubic feet of gas daily in 1960 to 40.52 billion in 1961. A 7% gain is expected by the end of this year pushing capacity to 43.85 billion cubic feet daily.

. . . **Liquid production.** A spectacular 8% gain sending output to 43,468,282 gal. daily was registered last year and will continue this year to an expected 47 million gallons daily.

The Oil and Gas Journal's annual gas-processing survey also turned up a similar growth in Canada, where gas-processing capacity increased almost 27% in 1960.

Canadian capacity had reached 2.12 billion cubic feet of gas daily at the start of this year, but 10 new plants now under construction there will push capacity to 3.15 billion cubic feet daily by the end of the year.

On the processing side, the survey turned up these interesting trends:

. . . **Refrigeration** facilities are being added by many operators to their existing absorption plants for higher LPG recoveries.

. . . **Increased emphasis** is going to higher LPG recovery, removal of helium, H_2S, and CO_2.

Indications are that LPG production will be more than double the production of natural gasoline by the end of 1961. Production of propane alone rose 22% to 10.2 million gallons daily during the year and came within 3 million gallons of natural-gasoline output.

These production figures more than anything else emphasize the complete about-face the "natural gasoline industry" has made in the last 10 years and explains why operators now prefer it be known as the "gas processing industry."

Capacity . . . The capacity increase of 5 billion cubic feet daily made last year was the best showing in the last 5 years.

Of the capacity gain, about 1.54 billion cubic feet is due to inclusion in the survey for the first time of short-cycle, hydrocarbon adsorption units. Facilities for helium recovery and CO_2 removal also were included for the first time.

Louisiana racked up the largest increase in capacity of any individual state with a climb of 2.82

Fractionation Changes Product Breakdown

THE Journal's annual gas-processing survey doesn't take into account the separation of LPG-natural gasoline streams which is done in several large gas-liquids fractionation centers in the Southwest.

Until recently, this has been a relatively minor factor in the gas-liquids picture. Growth of gas-liquids production, however, and construction of more fractionation centers are changing the breakdown of gas-liquids products.

The accompanying table shows the over-all U. S. distribution of products from gas-processing plants and fractionation plants outside refineries.

These conclusions can be drawn from a look at this table:

... **Volume of propane** recovered from natural-gas liquids and sold as end product last year exceeded the volume of natural gasoline blended into motor fuel.

Average daily production of propane was 12,290,000 gal., while average production of natural gasoline was 15,230,000 gal. per day. However, natural-gasoline streams are fractionated into special components in many refineries, and volume actually blended as such is more like one-half to two-thirds of this total volume.

Production of Gas Liquids

(From gas-processing plants and gas-liquids fractionators in the U. S.)

	Gal. per day
Propane	12,290,000
Isobutane	1,670,000
Normal butane	6,580,000
LPG mix	2,150,000
Combination LPG-natural gasoline stream	1,700,000
Isopentane	610,000
Natural gasoline	15,230,000
Heavier	3,270,000
Total	43,500,000

... **Volumes of butanes** recovered and sold as end products now approach the volume of natural blended into motor fuel. Average daily production of butanes was 8,250,000 gal. daily, and another 1.5 to 2 million gallons is almost certainly recovered by fractionation in refineries.

The table was compiled by adding the specific products produced at the natural-gas-liquids fractionation plants to the totals shown in the survey table on page 106. A corresponding total volumetric figure was then subtracted from the LPG-natural gasoline column.

Products usage ... The bulk of the daily production of 12,290,000 gal. of propane went to heating. But appreciable amounts of this material find their way into petrochemical feed stocks and engine fuel.

Almost all of the isobutane recovered as such is used for alkylation. Normal butane finds its way into home heating, petrochemical feed, engine fuel, and blending stock for bringing finished gasolines up to vapor pressure.

The combination LPG-natural gasoline production of 1,700,000 gal. daily moves into refineries to be fractionated into special components. Isopentane is blended into finished gasoline to give both octane and vapor pressure to the blend.

Heavier products, obtained mostly from cycling operations, are used to make kerosine, diesel fuel, stove oil, and other middle distillate products.

To the 3,270,000 gal. per day of these heavier products from natural-gas-liquids plants might be added another million gallons which is injected directly into crude lines, without being processed in a gas-liquids plant. This raises the total natural-gas-liquids production to about 44,500,000 gal. per day.

---

billion cubic feet daily above 1959 capacity of 4.89 billion.

Texas' capacity rose to 18.85 billion cubic feet from 16.97 billion cubic feet daily the year before.

Nearly 40% of the national increase, however, came from three huge new plants in the two states:

... **Humble's King Ranch** plant in Texas with capacity of 800,000 M.c.f. daily.

... **Union Texas Natural's** Payne plant in Louisiana with capacity of 700,000 M.c.f. daily.

... **Goliad's plant** on Cow Island in Louisiana with capacity of 450,000 M.c.f. daily.

Not all the gas-producing states showed capacity increases, however. A few where older fields have begun to decline recorded net decreases. This was particularly true in Kentucky.

Processing ... This year's survey represents the most complete breakdown ever made of products coming from the 633 plants reporting.

Only two companies declined to break down production into separate streams actually produced at individual plants. The more complete breakdown accounts for part of the increase in propane and butane production and the drop in LPG-mix and combined gasoline-LPG categories.

Product upgrading continued with one more plant beginning to process natural gasoline into finished motor gasoline. This brings the total of plants involved in this type of processing to 10. Their production of upgraded motor fuel was 646,187 gal. daily.

It is interesting to note that more plants now are extracting ethane from the gas being processed. Ethane and ethane-propane mix were produced at a rate of 1,338,562 gal. daily during 1960 from 14 plants.

Some of the ethane production resulted from deeper extraction for propane and is either being reinjected into the residue gas stream or used for plant fuel. But other plants have installed facilities specifically for recovering ethane and are selling it to chemical plants for upgrading into ethylene.

Construction ... Outstanding projects currently under way:

... **World's largest** gas-processing plant will be built by Northern Gas Products Co. to handle 900,000 M.c.f. daily of gas from one of Northern Natural Gas Co.'s transmission lines.

... **Helium-recovery** plants have

Largest gas-processing plants

(Plants with Capacities of 400 M.M.c.f.d. or Over)

Rank	Company, Plant	State	Capacity (M.c.f. daily)
1	Tenessee Gas Pipeline Co., Gabe	Ky.	925,000
2	Humble Oil & Refining Co., King Ranch	Tex.	800,000
	Union Texas Natural Gas Co., Eunice	La.	800,000
3	Union Texas Natural Gas Co., Rayne	La.	700,000
4	Pan American Petro. Corp., Old Ocean	Tex.	570,000
5	National Petro-Chemicals Corp., Tuscola	Ill.	560,000
6	Humble Oil & Refining Co., Katy	Tex.	555,000
7	El Paso Natural Gas Co., Blanco	N. M.	550,000
8	Carthage Co., Carthage	Tex.	475,000
9	Goliad Corp., Cow Island	La.	450,000
	Warren Petroleum Corp., Maysville	Okla.	450,000
10	Phillips Petroleum Co., Goldsmith	Tex.	440,000
11	Shamrock Oil & Gas Corp., McKee-Sunray	Tex.	400,000

Reprints Available

THREE separate tables on gas-processing facilities start on Page 106. The plant-by-plant survey shows capacities and production at U. S. and Canadian plants, and construction projects in both countries.

Reprints of this survey will be available at $2 per copy. Send requests to Reader Service Department, The Oil and Gas Journal, Box 1260, Tulsa, Okla.

been announced by three private concerns. This marks the first time that anyone other than the Government has attempted to recover helium from natural gas on a commercial scale. Two of the plants are planned under the Government's new helium conservation program (OGJ, Sept. 19, p. 65) in which the Government would agree to buy all the output for a price that will guarantee the operator a profit. Kerr-McGee, however, plans a plant not covered by this program.

. . . **Short-cycle,** hydrocarbon adsorption plants with capacities of 100,000 M.c.f. daily or more are planned for operation during 1961.

Continental Oil Co. placed on stream in January, a 175,000 M.c.f. daily plant in South Louisiana that is designed to dehydrate and recover 40,000 gal. per day of liquid hydrocarbons from offshore gas. Atlantic Refining Co. is constructing a 100,000 M.c.f. daily unit near Hebbronville, Tex. with an expected liquids recovery of 9,990 gal. per day.

Canadian operations . . . Gas-processing capacity in Canada increased by 562 million cubic feet daily in 1960.

The 50 plants responding to the survey reported total capacity of more than 2.12 billion cubic feet per day as of Jan. 1, 1961.

Gas exports to the U. S. have played a big role in the new growth of processing capacity (OGJ, Apr. 11, p. 83). Also, the advent of short-cycle, hydrocarbon adsorption units that can operate essentially unattended in remote areas has had its impact on capacity.

British-American president E. D. Loughney, commenting on the installation of a short-cycle plant, said ". . . it is one of 20 or more small, prefabricated plants which various companies will have to build in western Canada before the end of 1961 as new fields are brought into production to meet growing export demand."

The 10 new plants and expansions under way or planned include five projects with capacities of 100,000 M.c.f. daily or more. This new construction is expected to push total capacity to an estimated 3.15 billion feet by January 1, 1962.

Liquids production at Canada's gas-processing plants soared to 1,311,644 gal. per day last year, a 24% increase over 1959. The production ratio of LPG to natural gasoline is presently about 1:1, but if plans for LPG pipelines to the U. S. are followed through, this ratio should change considerably in favor of LPG (OGJ, Jan. 30, p. 86).

The new projects should increase production of hydrocarbon liquids to more than 2.77 billion gallons daily during 1961, over twice the 1960 daily rate.

Tidewater-Pan Am Bid for Honolulu Favored

PAN American Petroleum Corp. and Tidewater Oil Co. jointly have submitted the high bid to buy Honolulu Oil Corp.

They reportedly have offered $91 a share, or $341.5 million. The next two bids in a close contest for Honolulu's assets reportedly were $89 and $88 a share.

L. A. Cranson, Honolulu's president, said the joint Pan American-Tidewater offer looks like the best bid received, but no deal has been closed.

"We're trying to work out a deal with them," he said.

Just how long the negotiations will last is uncertain.

Several other companies submitted bids. These have not been rejected, but apparently they are out of the running. However, all offers were made with the understanding they would be valid until May 15.

Reports in the industry last week were that Honolulu's assets will be split if the Pan Am-Tidewater bid is accepted.

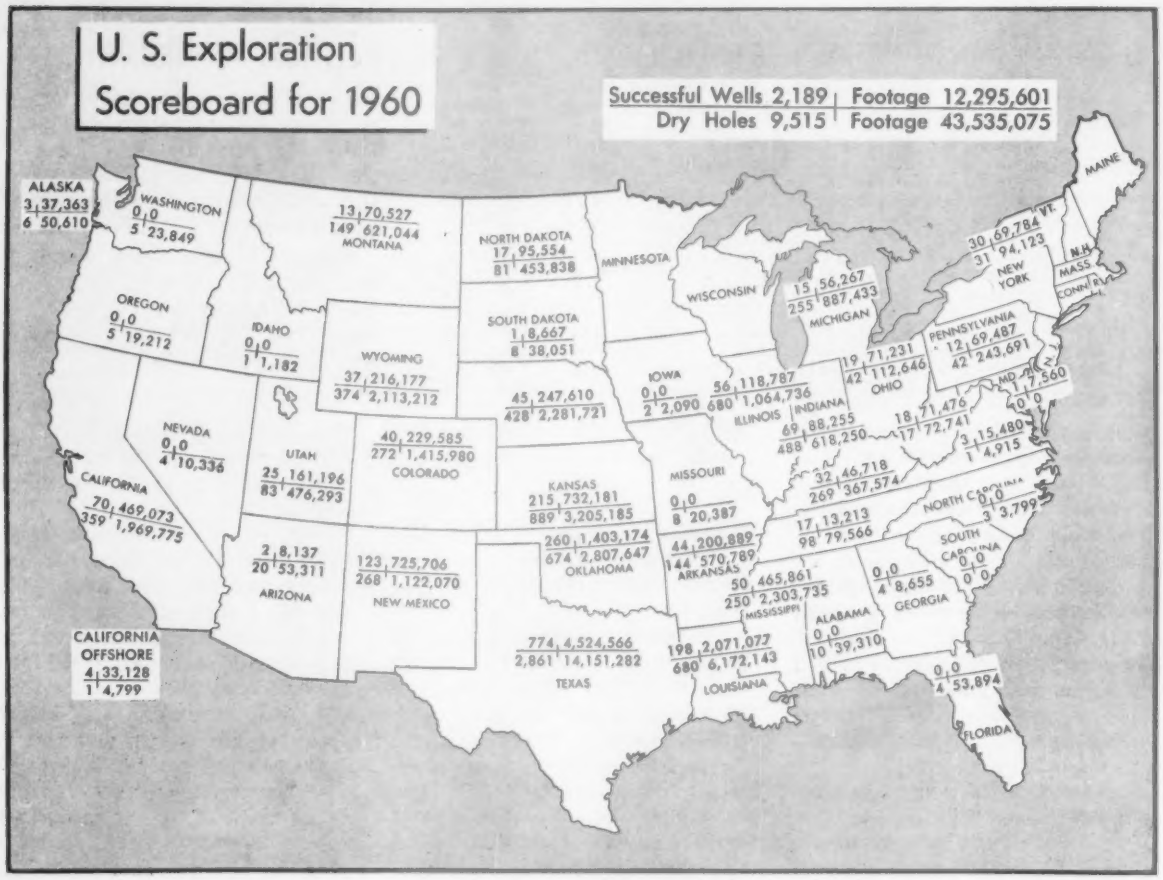
Tidewater, reports said, is scheduled to take all Honolulu properties west of the Rocky Mountains, and Pan American would take over all those properties east of the Rockies.

Reports were that the sale would be handled by liquidating payments rather than by a lump-sum payment to Honolulu.

What's involved . . . Honolulu has a gross daily crude production of about 47,000 bbl.

The company has about 18,000 bbl. production in the Mid-Continent area and 14,000 in California. Rocky Mountain production totals about 9,000 gross barrels daily and Canadian output is 6,000 gross barrels daily.

An engineering report prepared prior to sale reportedly showed Honolulu's proved reserves at 120 million barrels and the secondary reserves at 180 million barrels.



Exploration Showing Is Worst in 12 Years

• Last year's percentage of successful domestic exploratory wells and the number of discoveries slid to lowest levels since 1948. AAPG also says only one in 60 of the "new-field wildcats" of 1954 has shown a profit.

THE DOMESTIC OIL industry last year made its poorest showing since 1948 in finding new oil.

The percentage of "successful" exploratory wells was down to a 12-year low. And the same applied to the total number of discoveries.

Even more dismal are the statistics showing that 1954's "new-field wildcats" — those drilled on nonproducing structures — have proved profitable in only one well out of 60.

These figures are based on a 6-year development history of discovery wells in this category between 1954 and 1960.

The information on exploratory wells is contained in the annual report released last week in Houston by the committee on exploratory drilling of the American Association of Petroleum Geologists.

J. Ben Carsey, exploration adviser for Humble Oil & Refining Co., is chairman of the committee.

The over-all "success" ratio last year was 18.70%. This compares with 19.83% for 1959 and 19.46% in 1958. Back in 1948 the ratio was 18.25%, the only time it was lower than last year's since statistics were first compiled in 1944.

The industry last year drilled 11,704 exploratory holes, and all but 2,189 were dry. Footage total was 55,830,676 — an average of 4,770 ft. per well, or 30 ft. less than the year before.

In compiling the statistics, the AAPG committee first classified exploration tests into five categories — outpost, shallower-pool test, deeper-pool test, new-pool wildcat, and new-field wildcat.

Of the 11,704 exploratory tests made, 7,320 were in the new-field-wildcat category and less likely to find oil than the others.

Significantly, the percentage of new-field wildcats drilled last year was 62.54% of the total, compared with only 53.30% the previous year. This would help to account for the lower over-all percentage of discoveries.

This is especially true since the new-field discovery percentage itself went down to 10.18% last year, compared with 10.97% in

State-by-State Rundown of Exploratory Drilling in 1960

States—	Oil producers		Gas producers		Cond. producers		Dry holes		Grand totals		Average depth*
	Number	Footage	Number	Footage	Number	Footage	Number	Footage	Number	Footage	
Alabama	0	0	0	0	0	0	10	39,310	10	39,310	
Alaska	1	11,315	2	26,048	0	0	6	50,610	9	87,973	
Arizona	1	6,997	1	1,140	0	0	20	53,311	22	61,448	
Arkansas	11	35,321	31	149,082	2	16,486	144	570,789	188	771,678	4,105
California	27	205,198	43	263,875	0	0	359	1,969,775	429	2,438,848	5,685
Colorado	23	127,179	14	82,307	3	20,153	272	1,415,980	312	1,645,565	13,379
Florida	0	0	0	0	0	0	4	53,894	4	53,894	
Georgia	0	0	0	0	0	0	4	8,655	4	8,655	
Idaho	0	0	0	0	0	0	1	1,182	1	1,182	
Illinois	54	115,374	2	3,414	0	0	680	1,064,736	736	1,183,523	1,608
Indiana	61	77,460	8	10,795	0	0	488	618,250	557	706,505	1,268
Iowa	0	0	0	0	0	0	2	2,090	2	2,090	
Kansas	172	573,880	43	158,301	0	0	889	3,205,185	1,104	3,937,366	3,566
Kentucky	24	33,537	8	13,181	0	0	269	367,574	301	414,292	1,376
Louisiana	93	888,715	21	171,016	84	1,011,346	680	6,172,143	878	8,243,220	9,389
Maryland	0	0	1	7,560	0	0	0	0	1	7,560	
Michigan	11	42,869	4	13,398	0	0	255	887,433	270	943,700	3,495
Mississippi	40	382,684	10	83,177	0	0	250	2,303,735	300	2,769,596	9,232
Missouri	0	0	0	0	0	0	8	20,387	8	20,387	
Montana	11	63,888	2	6,639	0	0	149	621,044	162	691,571	4,269
Nebraska	44	242,466	1	5,144	0	0	428	2,281,721	473	2,529,331	5,347
Nevada	0	0	0	0	0	0	4	10,336	4	10,336	
New Mexico	80	457,343	32	160,087	11	108,276	268	1,122,070	391	1,847,776	4,726
New York	0	0	30	69,784	0	0	31	94,123	61	163,907	2,687
North Carolina	0	0	0	0	0	0	3	3,799	3	3,799	
North Dakota	17	95,554	0	0	0	0	81	453,838	98	549,392	5,606
Ohio	3	11,319	16	59,912	0	0	42	112,646	61	183,877	3,014
Oklahoma	176	926,112	71	378,055	13	99,007	674	2,807,647	934	4,210,821	4,508
Oregon	0	0	0	0	0	0	5	19,212	5	19,212	
Pennsylvania	0	0	12	69,487	0	0	42	243,691	54	313,178	5,780
South Dakota	1	8,667	0	0	0	0	8	38,051	9	46,718	
Tennessee	13	7,411	4	5,802	0	0	98	79,566	115	92,779	807
Texas	421	2,298,582	212	1,071,878	141	1,154,066	2,861	14,151,282	3,635	18,675,848	5,138
Utah	11	76,514	13	76,915	1	7,760	83	476,293	108	637,489	5,903
Virginia	0	0	3	15,480	0	0	1	4,915	4	20,395	
Washington	0	0	0	0	0	0	5	23,849	5	23,849	
West Virginia	1	2,133	17	69,343	0	0	17	72,741	35	144,217	4,120
Wyoming	25	138,598	12	77,579	0	0	374	2,113,212	411	2,329,389	5,668
Total	**1,321**	**6,829,116**	**613**	**3,049,399**	**255**	**2,417,094**	**9,515**	**43,535,075**	**11,704**	**55,830,676**	**4,770**
Average depth per hole		5,170		4,975		9,479		4,575		4,770	

*Average per-well footage given only where 25 or more wells were drilled in the state.

1959 and 11.32% the year before.

Profits . . . What really tells the story of the so-called "success" in drilling, however, is not so much the current exploratory data but the statistics released by the committee revealing how many tests ultimately show a profit over a given period of years.

The statistics are confined to the new-field wildcats and cover 6 years of development for the discoveries of each year beginning with 1944 and ending with 1954. Thus the 1954 wells had a development history of 6 years by 1960.

The report said the ratio of profitable fields discovered each year to total new-field wildcats drilled ranges from 1-to-36 in 1944 to 1-to-60 in 1954.

This means 1954's new-field wildcat drilling resulted in 98.34% failure. Either the wells went dry or their discovered reserves were too small to be profitable.

It is interesting to note that the so-called "success" ratio for new-field wildcats was reported in 1954 to be 12.4%, or one in 8, but by the time 6 years of experience had passed only 1.66% of the wells, or 1 in 60, showed a profit.

Canada . . . The ratio of discoveries

in western Canada was considerably better than in the U. S. last year.

Of 818 exploratory holes drilled, 249 were producers. This was a 30.44% success ratio, down only slightly from the 30.72% in 1959 when 905 exploratory wells were drilled. The average depth of the wells in 1960 was 5,357 ft.

In eastern Canada, 13 of 102 tests were successful for a 12.75% success ratio.

Mexico . . . Mexico did even better than Canada and also better than its own 1959 drilling. Its 178 exploratory wells had 76 discoveries for a 43% success ratio. Average depth was 7,167 ft.

Natural gas . . . The statistics on natural-gas discoveries are confined to the 17 chief gas-producing states and seek to evaluate the discoveries over a 6-year development period.

They show that 69.58% of the gas discoveries listed in 1954 have proved to be unprofitable. The AAPG committee also compiled a sliding 3-year table of gas discoveries between 1952 and 1954 and found that 63.43% of the discoveries ultimately proved unprofitable.

New sweetening process in use for natural gas

A NEW METHOD of desulfurizing natural gas is being used by a Canadian firm.

In one of the first commercial applications of the process, a molecular sieve sweetening unit has been placed on stream near Edmonton by Sage Oil Co. to handle 687,000 M.c.f. of sour gas daily.

At the same location, the company has installed a short-cycle, hydrocarbon adsorption unit for removing water and condensable hydrocarbons before sweetening.

The two units are similar in operation. But the sweetening unit uses molecular sieves (calcium alumino silicate) to adsorb hydrogen sulfide (see p. 89), while the other unit uses silica gel to remove the hydrocarbons and water.

Although regeneration gas from the sweetening unit must be flared to dispose of hydrogen sulfide, gas losses don't exceed 2%.

Sales-Commission Plan on Tires

THE Federal Trade Commission last week struck a heavy blow at commission arrangements between major tire manufacturers and major oil companies .

The FTC action hits at the practice in which an oil company receives from 7½ to 10% commission on sales of tires, batteries, and accessories made to its independent service stations and wholesale outlets by tire companies.

Specifically, the FTC ruled that such arrangements by Shell Oil Co. and Atlantic Refining Co. with Goodyear Tire & Rubber Co. and Firestone Tire & Rubber Co. are illegal.

The FTC also upheld an earlier finding by a trial examiner that Shell and Atlantic were guilty of coercing their lessee station operators into buying the TBA items from the tire companies.

Another case involving Texaco Inc. and B. F. Goodrich Co. was sent back to the examiner because, the FTC said, the record did not contain enough market data to show the competitive effect of the commission arrangement between these two firms.

The remanding of the Texaco-Goodrich case tended to point up the fact that the FTC was not outlawing all such commission arrangements. Rather, it apparently is trying to seek out those which it feels have an undesirable competitive effect.

Even so, the FTC action against Shell and Atlantic makes it clear that these types of commission arrangements will now be under a cloud—at least until the courts have finally settled the issue.

Shell and Atlantic both indicated they would appeal in the federal courts.

Atlantic noted that the ruling "reverses" a previous decision by the commission's own examiner, who took position that this type of contract was entirely legal and proper."

W. F. Kenney, vice president and general counsel of Shell, said he did not believe the commissioners made a correct interpretation of the law.

It is virtually certain that the tire companies also will appeal to the courts.

FTC reasoning . . . The commission ruled, in the Shell and Atlantic arrangements with Goodyear and Firestone, that competition was being hurt at both the retail, wholesale, and manufacturing levels.

Marketers and retailers, the FTC said, were unfairly restricted because their choice of TBA items was limited (the companies argued that the service-station dealers have had a free choice in their selection of TBA items).

At the manufacturing level, the FTC ruled, rival tire firms were hurt. The FTC said this stemmed from the fact that they had fewer possible outlets for their products because so many marketers and service-station operators were "bound" to buy from specific sources.

In the opinion of the commission, the damage done in the latter instance was even greater than that caused by the "coercion" of service-station operators by their major oil suppliers.

"From the point of antitrust laws, it is the devastating competitive effects of the sales-commission system on competitors of Firestone and Goodyear which raise the most grave questions," FTC Chairman Earl Kitner said.

The reason for this "devastating" effect, Kitners said, is that the smaller tire manufacturers lack the widespread distributive facilities of Firestone, Goodyear, and other nation-wide tire manufacturers using the sales-commission plan.

The end result, as the FTC sees it, is that the smaller tire companies have no opportunity for market expansion.

What plan now? . . . Although the FTC did not tell the companies what method they should use to replace the present commission plan, the opinion indicated the FTC felt the companies either should take no part in TBA arrangements or should use some version of the "purchase-resale" plan.

The agency noted that Atlantic had formerly used that system. It bought Lee tires, Exide batteries,

Held Illegal

and other accessories and sold them directly to its outlets. In that manner, Atlantic was involved with actual purchasing, financing, shipping, and selling of TBA items to various classes of retail and wholesale petroleum dealers.

However, the FTC said, Atlantic switched to the commission-agreement plan in 1950. Under this arrangement, the tire companies were responsible for the distribution, billing, and other duties while Atlantic's duty was solely to promote the products of the tire companies through its outlets.

The FTC implied that Atlantic did this because it felt this would be more profitable for it even though, according to the FTC, a survey had shown that Atlantic's outlets were satisfied with the old plan.

Hess adds more service stations in market drive

LEON HESS is beginning to carry out plans to become a marketer of branded gasoline, thus making his Hess Trading & Transport, Inc., a truly integrated company.

To the two Hess stations opened last summer in northern New Jersey, he has added half a dozen more. And the company is continuing to buy outlets for refurbishing and conversion to the "Hess" brand.

Heretofore Hess has marketed the output from his 75,000-bbl. Sewaren, N. J., refinery through private-brand jobbers and dealers.

He has a part ownership in Meadville Corp., which operates service stations in northern New Jersey under Saveway, Merit and Giant brands.

Hess started out as a one-truck fuel-oil distributor. From this he developed a sizable fuel-oil jobbing and terminaling business in the New York Harbor and Gulf Coast areas.

The only independent refiner on the East Coast, Hess last summer branched out further into pipelining and oil production (OGJ, Aug. 15, 1960, p. 86, and Aug. 22, 1960, p. 59).

watching WASHINGTON

Clyde La Motte

• Why not let Government 'stabilize' everything? . . .

WHEN YOU GET down to the brass tacks of it, the chief apparent reason for continuation of the residual fuel import program is to enable the Government to exercise judgment for the industry—judgment it figures the industry won't exercise on its own.

Under the revised program, importers will be permitted to bring in all the resid needed to fill the gap between domestic supply and total demand. That causes one to wonder why any resid control program is needed—because the imports will merely supply a market that domestic refiners don't want. There's no national security involved in this.

But Government officials figure that if they lift controls entirely, the oil industry will flood the East Coast with resid imports—thereby upsetting the market for both oil and coal.

Therefore—since the industry doesn't have more sense than to foul its own nest, the Government figures—the Government has to step in to keep market conditions stable for the industry's own good.

It may very well turn out that governmental control of resid imports will do that very thing. If so, following that line of reasoning, maybe the next logical step would be for the Government to start controlling domestic refinery runs—for it seems that these runs have a habit of getting out of hand.

And while they are about it, perhaps Government officials may as well "stabilize" other segments of the industry—such as setting quotas and prices for everyone from producer to service station!

After all, only a few companies spoke out with vigor against resid controls when Interior held its public hearing recently. Maybe more and more of the industry likes the idea of letting Uncle Sam make decisions for oil.

• New resid program is an improvement over the old . . .

SINCE IT IS obvious now that resid controls are likely to be with us for some time to come, an evaluation of the path Interior is taking appears to be in order.

It makes common sense that Interior has quit trying to use 1957 resid-import levels as a yardstick for establishing current levels. That approach never did work. Every time Interior tried to trim imports back to something like the 1957 flow, it had to issue supplementary allocations before the allocation period had ended. This just created uncertainty and a constant state of turmoil.

The new approach, which bases allocations on supply-demand forecasts by the Bureau of Mines, will at least avoid that pitfall.

• 'Captive' accounts get a little more freedom now . . .

INTERIOR also made some progress toward solving the problem of the so-called "captive" accounts.

Some resid buyers who weren't eligible for quotas had complained bitterly, that they had to buy all their resid—and perhaps some No. 2 fuel oil also—from a single supplier with a quota, or the supplier would threaten to cut them off entirely.

The new system makes some newcomers eligible and it also reduces by 3% annually the amount of the total quota that will go to "historic" importers. Thus the door will gradually be opened for the nonhistorics.

And don't overlook the peaceful stability we're all going to enjoy with the Government boys looking after things for us.

Oil May Have Cash Surplus for Next 3 Years

FOR the first time in a decade the oil industry last year provided all its needed capital from cash generated internally.

And the outlook is for a surplus over present requirements for dividends and capital outlays of as much as $1 billion during the next 3 years.

This reversal of the trend of outside borrowing is reported in an industry analysis by Kenneth E. Hill, of Eastman Dillon, Union Securities & Co., New York investment bankers. He also discloses:

. . . Investment emphasis has shifted toward domestic operations, since return on foreign oil investment has dropped below 13% and so is less attractive than U. S. investments at 9% return.

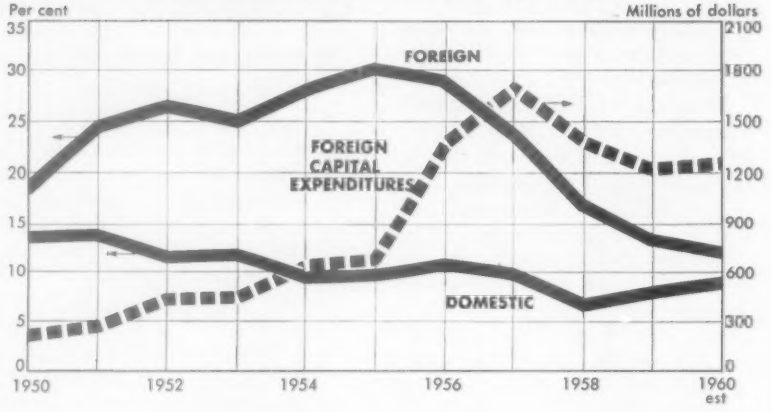
. . . The net inflow of $330 million in earnings above foreign investment of U. S. operators, existing as recently as 1955, has been reversed exactly.

. . . Industry operating costs have been cut about $500 million during the past 3 years, with a proportionate increase in net earnings after taxes.

The figures are derived from financial and operating results for the 32 companies included in the Chase Manhattan Bank survey.

Return on Net Assets

Foreign profits rose, so investment rose . . . then profits dropped.



They represent 62% of crude production and 85% of refinery throughput in the U. S., and 60% of free-world crude production and refinery throughput.

Capital self-sufficiency . . . The oil industry historically has provided almost all its needed funds internally, Hill notes.

But during 1952-59 the companies studied required more than $2½ billion from outside sources in order to support a stepped-up rate of expansion.

This trend has been halted by curtailed capital spending, brought on by a world surplus of producing and refining capacity, and by growing cash income.

Last year, the 32 companies retained some $230 million after dividends and capital expenditures. The main reason: Cash income increased $300 million while capital spending held about level.

The surplus is expected to continue for a few years until the excess capacity is absorbed and capital spending must be boosted once more.

Hill has two suggestions for disposing of the extra money. The companies can increase dividends to pre-war ratios of 55 to 60% of net income from the present rate of 45%. And they can buy properties of other operators since "crude oil and natural-gas reserves (and other assets, as well) sell at large discounts in the stock market."

Profitability trend . . . The return on net assets for the oil industry averaged above that for all manufacturing through 1954, but has been generally lower since.

Return declined steadily from about 15% at the beginning of the decade to around 10%, Hill's analysis reported. There has been little improvement from the low level of 1958.

But the over-all figures mask the impact of foreign earnings on this trend. While domestic return has

Dixon Wants FTC Speed-Up

THE NEW chairman of the Federal Trade Commission, Randall Dixon, plans to emphasize a speed-up of FTC handling of cases.

That's what he told a Senate committee last week during a hearing on his confirmation.

Dixon was able to speak in more detail than most of the new appointees to regulatory agencies because of his long experience as a staff man at the FTC.

Except for military service, he served at the agency from 1938 to 1957, when he became counsel and staff director of the Senate Antitrust and Monopoly Subcommittee under Sen. Estes Kefauver (D.-Tenn.).

Among the ideas he suggested last week were these:

. . . Assign an attorney to stay with a given case all the way through, rather than have one man do the investigating, another the trial work, and so on. This, Dixon feels, would save lots of time.

. . . Strengthen field staffs so that area problems could be handled on an area basis. This would lessen the need for hauling all defendants to Washington.

. . . Hire more trial examiners. Dixon says the present 15 are so bogged down that months-long and years-long delays result.

. . . Realign functions so that one man, rather than several, is responsible. This would reduce buck-passing and enable the commission to pinpoint delays and inefficiencies.

declined from about 14% to 9%, the drop has been more startling abroad. From 1950 to 1955, increased earnings combined with low capital outlays boosted return from 18% to 30%, but since then it has plummeted to 13%.

"Noticing the large, profitable and increased earnings of the five United States internationals during 1950-55, other large domestic companies resolved to participate in what appeared to be a bonanza," Hill said.

"So they stepped up their foreign capital expenditures, particularly for Venezuela concessions, in 1956 and 1957. The existing internationals, determined to maintain their dominant position, also bought their share of these concessions."

The flush new Lake Maracaibo discoveries, combined with increased Middle East production, heightened foreign competition and depressed prices and profit margins. This is what Hill called "the classical correction of too good a thing."

"Capital flowed in where earnings were much higher than could be obtained at home, and the ensuing over-capacity caused lower return on investments," he said.

"Now, the pendulum having swung too far, foreign investments earning less than 13% are no longer as attractive as domestic earnings, always being mindful of foreign political risks."

He said the industry should not be satisfied until domestic return is increased above 10% and foreign return above 15%.

Foreign income provided most of the earnings increase from 1950 to 1957 but the opposite has been true since then. Domestic profits reached a new peak while foreign earnings were declining, Hill said.

Operating costs . . . The cost-cutting efforts are bearing fruit, the study shows, and should continue to bolster earnings.

Operating costs and expenses averaged 72% of gross income during the first half of the decade. They reached a peak at 75.4% in 1958, and have since dropped below 74%. They are still going down.

Progress in decreasing costs corresponded with increases in gross income and has thus shown up in an increase in net income from 8% to more than 9% of the gross.

Diehl Receives Hanlon Award

- **Top honor in gas-processing industry goes to retired board chairman of American Meter for notable services.**

THE Hanlon Award, highest honor in the gas-processing industry, was conferred last week on John C. Diehl, retired chairman of the board of American Meter Co.

Diehl is the twenty-fifth recipient of this annual award of the Natural Gasoline Association of America for outstanding service to the natural-gasoline and gas-processing industries. Presentation was made at the association's fortieth annual convention in Dallas by NGAA President Charles E. Webber, Sun Oil Co., Philadelphia.

The citation read in part: "This man has made many significant contributions to our industry as an individual. He not only made many discoveries of great value, but he recognized industry need for them and he had the ability to explain his ideas in written texts so that they could be applied in the field. A whole generation of gas measurement men, the gas industry and the gas-processing industry owe this man a vote of thanks and gratitude for his monumental aid in making their operations easier and much more accurate."

Diehl graduated from the Massachusetts Institute of Technology as a civil engineer. After World War I, he joined American Meter Co., becoming chief engineer in 1929, president in 1950, and chairman of the board in 1951. He retired in May 1956.

John C. Diehl

His first book, "Measurement of Gas and Liquids by Orifice Meter," was published in 1922 and immediately became the measurement "bible" for the industry.

In 1927, the best known of all his publications, "Natural Gas Handbook," was published. This book is still a standard reference in many universities and throughout the industry.

Donor of the Hanlon Award is E. I. Hanlon, chairman of the board, National Bank of Tulsa, and a pioneer in the natural-gasoline industry.

German "ALFOL" Plant Set

CONTINENTAL Oil Co. and Deutsche Erdol AG (DEA), a German oil company, have formed a company to build a petrochemical plant near Hamburg.

The plant will produce and sell Continental's "ALFOL" line of industrial alcohols.

Similar to a Continental plant being built at Lake Charles, La., it will have a 50,000-ton capacity.

Output will be marketed in the European Common Market countries of West Germany, France, Belgium, The Netherlands, and Luxembourg.

The new German-based firm, owned 50-50 by the American and German companies, will be known as CONDEA Petrochemie G.m.b.H.

DEA's refinery at Heide, near the CONDEA site, will furnish ethylene for the new plant.

DEA has built a small-scale plant to produce one drum daily of "ALFOL" samples for use in developing markets before the CONDEA plant is completed in mid-1963.

Oil Can Have a Good Year—IF It's Careful

• That's the consensus given the Texas Railroad Commission by top executives. Runs must drop, but stocks are reasonable, they say. Nine days set for April.

CAUTIOUS optimism tempered with concern over record-high refinery runs and climbing product inventories was reflected last week by oil-company executives in Austin.

Top executives of two dozen of the nation's largest integrated oil firms testified on stocks of crude and products, refinery runs, and imports during the Texas Railroad Commission's annual spring check of the industry's pulse.

Consensus was that the industry is in reasonably good shape and should have a good year if it watches its P's and Q's. Inventories are not badly out of joint on the whole.

But the situation could deteriorate quickly, however, if refinery runs aren't slashed heavily in March and April. Testimony indicated that runs are being cut sharply from February's record levels.

Moderate demand gain . . . Though not asked by the commission for demand forecasts, spokesmen for most major firms gave them, and generally they look for a modest gain on the order of 2% or slightly more.

C. B. Barrett, senior vice president of Texaco Inc. said Texaco looks for a demand gain of 2 to 3% in this country and a rise in free world demand of about 7% this year.

Other forecasts: Gulf, 2%; Cities Service, 2.7%;; Standard of Indiana, 2 to 3%; Sun, 2 to 2½%; Sinclair, 1 to 2%; Standard of California, 1.25%.

General feeling was that domestic production may increase some more than demand, due to the fact that much of last year's demand was filled from inventories.

Short on crude . . . Company executives were asked by the commission this year to give actual and desired levels of their own inventories rather than their ideas on desired industry levels.

Totaled up, these figures show the reporting companies to be 8,469,800 bbl. short of crude in storage—with a total 181,835,200 bbl. in stock as against a desired level of 190,305,000 bbl.

But they are long on all products except residual.

Their gasoline stocks as of March 1 stood at 180,374,500 bbl. for a surplus of 4,777,500 bbl. Kerosine was 1,479,800 bbl. above desired at 17,853,900 bbl. and distillate stocks had piled up to a point 6,453,300 bbl. over desired at 81,624,300 bbl.

Resid stocks, at 32,884,800 bbl., were 1,320,200 bbl. below desired.

Of the crude in storage on March 1, less than half, or only 87,121,500 bbl., was considered by the companies as readily dispatchable.

Refiners Announce Cuts in Runs

SEVERAL of the nation's big refiners told the Texas Railroad Commission last week they are cutting their crude runs.

Their announcements followed reports to the commission showing that February runs were up sharply from January.

Total of February runs shown in the table isn't comparable with totals of previous month, when only those companies buying Texas crude reported. Last week's meeting, special in nature, brought executives from a number of companies which normally do not report to the commission.

But a glance at operations of 13 majors which have reported for 4 consecutive months shows their runs up from a total of 5,514,263 bbl. daily in January to 5,576,807 bbl. in February.

March as a whole is not likely to show a great drop, since runs over the nation reached an all-time record during the first week of the month.

Here is what companies told the commission they are doing:

Humble: Has cut 9%, or about 76,000 bbl. daily.

Continental: Is cutting runs to reduce its March average by 11,905 bbl. daily.

Indiana Standard: Cutting by 17.5% for March and April. Cutting March runs 90,000 bbl. and April runs 123,000 bbl. from February average of 700,000 bbl.

February Runs

Company—	Avg. in bbl. daily	% of capacity
Ashland	138,527	77.0
Atlantic Refg.	209,549	99.5
Cities Service	262,153	89.5
Col-Tex Refining	36,486	84.8
Continental	196,306	*102.0
Crown Central	34,998	87.5
El Paso Natural	18,357	83.4
Gulf	467,540	88.1
Humble	875,000	90.9
Phillips	221,800	80.9
Plymouth	35,069	77.9
Premier	13,496	61.3
Pure	165,150	88.3
Scurlock Shamrock	19,456	72.0
Shell	533,433	89.8
Signal	65,696	83.8
Sinclair	430,691	88.1
Socony Mobil	594,000	84.1
Standard (Calif.)	520,846	75.9
Standard (Ind.)	698,827	97.0
Standard (Ohio)	144,285	84.6
Standard (Tex.)	51,353	68.5
Sun	201,921	79.2
Suntide	44,233	68.0
Texaco	678,986	91.9
Tidewater	251,000	91.3
Total	6,909,158	

*Based on calendar-day capacity computed on balanced refinery runs for a year.

Sinclair: Cutting 22,000 bbl. daily.

Gulf: Will reduce to 82% of capacity.

Shell: Cutting 36,000 bbl. daily in March.

Socony Mobil: Cutting to 82.6% of capacity in March and to 77% in April.

Atlantic: Cutting 25,000 bbl. daily.

Dispatchable crude excludes oil required for pipeline fill and that below tank outlets.

Asked about imports into Texas, the companies' testified compositely to bringing into the state in February an average 10,713 bbl. daily from foreign sources and 583,804 bbl. daily from other states.

Output trimmed . . . Crude production in Texas will ease off in April in anticipation of the traditional spring lull in demand.

But it won't be cut as much as most majors would like.

The commission fixed the state's April pattern at 9 days and 2,822,-021 bbl. daily.

This is 98,821 bbl. daily less than the initial allowable for March and 107,609 bbl. daily below the allowable in effect March 4.

Of the dozen major buyers nominating for Texas crude, only four recommended a 9-day schedule, while seven sought 8 days, and one (Humble), nominated 10.

The commission appeared to favor crowding the market for Texas crude a bit more.

Such an attitude first was hinted late last year. And it became more apparent when the commission went to 10 days for March—the highest allowable in more than a year.

It's Time for That Big Drop in Demand

REFINERY runs were on their way down last week after setting an all-time record during the first week in March.

But whether they will drop enough — and stay down long enough—to keep the industry out of trouble is still to be seen.

This is the time of year when demand changes character. It's the shift from a fuel-oil to a gasoline economy. And this year there may well be a drop in demand of 1,400,-000 bbl. daily from the first-quarter level to the second-quarter level.

Over the past 6 years refiners have met this seasonal change in demand by juggling their inventories or easing off on product imports or gas-liquids production.

This year, however, that might not be enough. The current outlook indicates a need for a tight rein on refinery runs all through the second quarter.

It now looks as if first-quarter demand will average about 10,800,-000 bbl. daily. Second-quarter demand should average about 9,400,-000 bbl. daily.

How this drop in demand will affect prices, income, and profits will depend largely on what refiners do to hold down the supply of products.

A look backward . . . Last year's program for the same problem has little to recommend it.

Average demand for the 1960 second quarter dropped 1,498,000 bbl. daily. Runs remained high, dropping only 71,000 bbl. daily from the first-quarter average. Gas-liquids production eased off 46,000 bbl. daily and product imports 234,-000 bbl. daily.

Bulk of the adjustment was handled through storage. Total of 967,-000 bbl. daily of refined products went into storage along with 181,-000 bbl. daily of gas liquids.

The results weren't good. With runs high, gasoline stocks remained too high at midyear after setting an all-time record for inventory building in the first quarter. And prices showed the impact by dropping to a 6-year low.

Over the past 4 years the drop in total demand in the second quarter has been above 1,400,000 bbl. daily. Record for the 1955-60 period was 1957 when demand plunged 1,800,000 bbl. daily.

That big reduction was influenced by above-normal export sales in the first quarter during the Suez crisis. The normal reduction is about 1,500,000 bbl. daily.

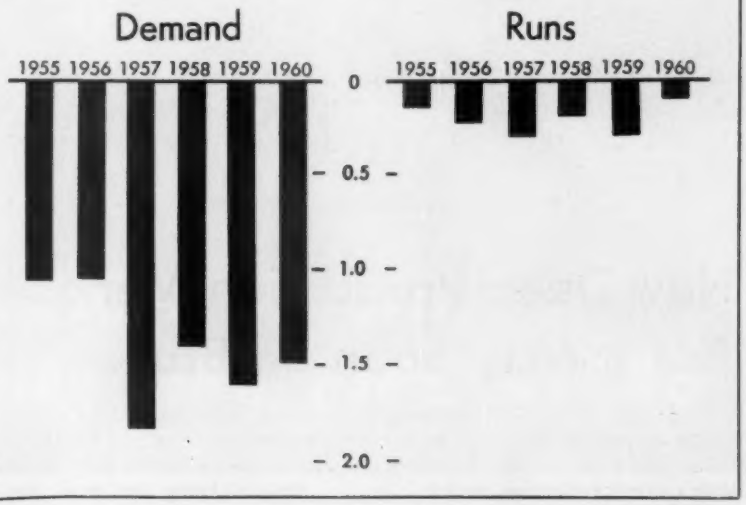
Only twice in the last 4 years have refiners really cut runs sharply to balance demand in the second quarter.

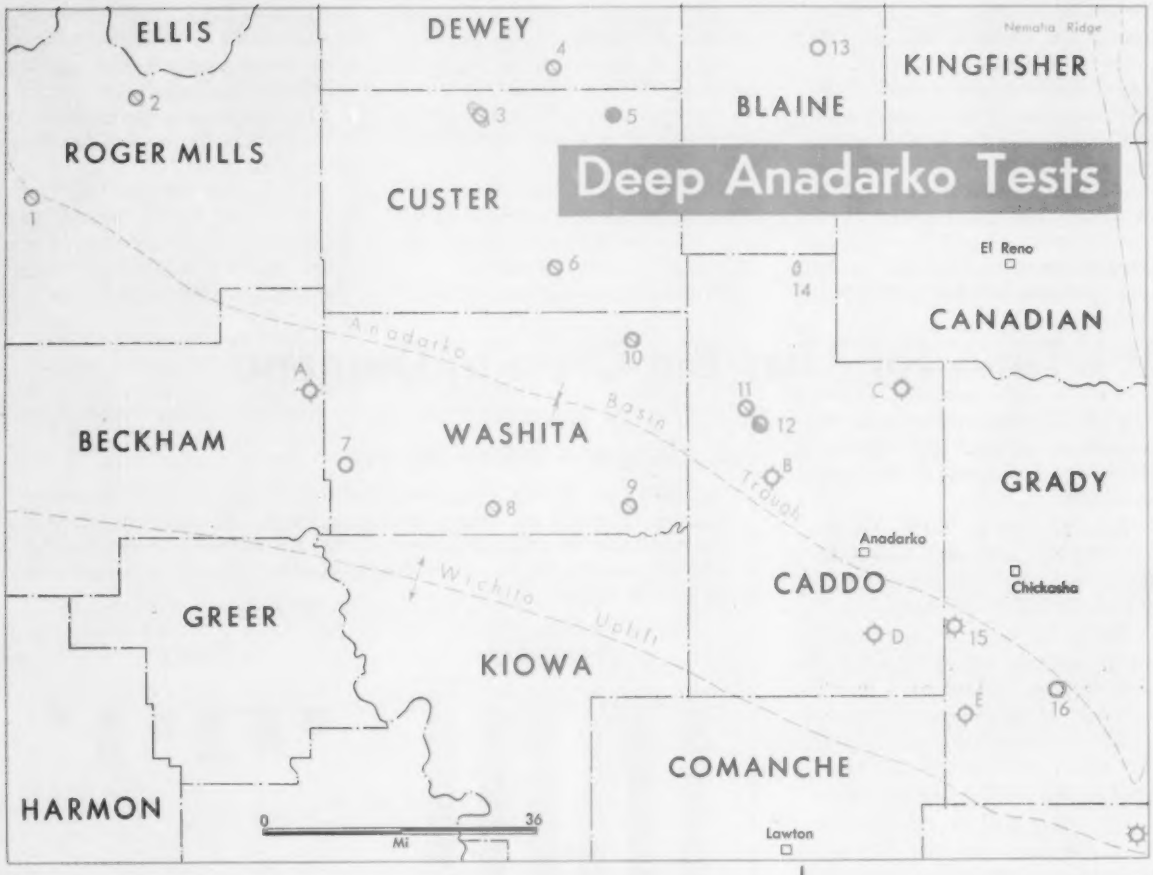
In 1957 runs dropped an average 270,000 bbl. daily and in 1959 the drop was 274,000 bbl. daily. In both instances the drop in demand—1,817,000 bbl. daily in 1957 and 1,620,000 bbl. daily in 1959—dictated severe action.

With a possible 1,500,000-bbl. drop in demand facing the industry over the second quarter this year, refiners should slow down their runs on an average of at least 200,000 bbl. daily to get nearer a good supply-demand balance.

It Happens Every Spring:

Each year there's a big drop in demand from the first to second quarter. Runs don't change nearly so much. Shown here are the decreases in demand (first-quarter average less second-quarter average), with the comparable decreases in refinery runs. Figures are in millions of barrels daily.





New Deep Production Mark Set But It May Soon Be Broken

A DEEP-WILDCAT campaign in the trough of Oklahoma's Anadarko basin has already busted the state's deep-production record.

And the new record could be bested soon by other wells drilling or planned for the area.

The new holder of the deepest-producer title is the 1 Wood, a gas-condensate well brought in by Gulf Oil in Grady County. Production is at intervals from 16,180 to 16,376 ft. Total depth is 17,000 ft.

Nine tests drilling or planned along the trough route are scheduled to go to the total depth of the 1 Wood or beyond.

Although the Anadarko basin has been one of the country's biggest oil-hunting grounds, only six tests before the 1 Wood went 17,000 ft. or deeper.

The previous deep-production record in Oklahoma was at British American 1 Krieger in Stephens County. That well had Ordovician gas-condensate at 16,546 ft. But later it was completed up the hole.

Besides being the new deepest producer, the 1 Wood is believed to be the deepest Pennsylvanian producer ever. On a 24-hour test through a 13/64-in. choke the well flowed at 5,000 M.c.f. daily and condensate was estimated at average rate of 30 bbl. per million cubic feet. Tubing pressure was 3,738 psi.

New contenders . . . Several new drilling records in the basin are possible soon.

A 9-section unit is being put together in Washita County in preparation for a wildcat in C SE 28-9n-20w (No. 7 on map). Shell is expected to be the operator on the test which would go to 20,000 ft.

The location would be about 2½ miles north of West Sentinel field. Shell has drilled a 14,016-ft. dry hole northwest of the proposed location.

A Custer County test to 17,000

New Deep Tests

Map Key	Well	Target
1.	Gulf 1 Hartley	15,500
2.	Phillips 1 Young	16,000
3.	Hunt Northwest Anthon	15,650
4.	Mobil 1 Herring	15,500
5.	Mobil 1 Horton	14,869
6.	Ellison et al. 1 Wagner	17,000
7.	Shell	20,000
8.	Humble 1 Schmidt	17,000
9.	Gulf 1 Tabor	17,000
10.	Conoco 1 North Corn	20,000
11.	Ellison 1 Smith	17,000
12.	Ellison 1 Miller-Long	21,500
13.	Texaco	15,000
14.	Mobil 1 Weathers	11,476
15.	Gulf et al. 1 Wood	17,000
16.	Mobil	17,000

Deep Dry Holes

	Company	T. D.
A.	Shell	24,002
B.	Superior	17,823
C.	Denver	17,094
D.	Mobil	20,426
E.	Frankfort	18,158

A 60-INCH VIEW OF CAT'S POWER SHIFT 583 PIPELAYERS

Report from Jack Hodges, General Supt., J. P. Neill & Company, Inc., Birmingham, Alabama

"The power shift on the new Cat 583 allows split-second shifts when juggling 60″ pipe. The operator can handle the draw works levers and change travel speeds by nudging the *single* transmission lever with his forearm—impossible otherwise. When climbing these grades, he can smoothly drop to a lower gear to keep the load moving. Machines with other type transmissions must stop and slow down the operation."

Jack Hodges is talking about performance from the two 583s working on the industrial water line from Fort Smith Dam to Birmingham, Ala. They're handling 60″ pipe, weighing 20,000 lb. per 40′ joint, over rough terrain with grades up to 67½ degrees. "It's the kind of job that brings out the best and shows up the worst in any machine. That's why the 583s look so good."

The beautifully engineered combination of 235 HP, 137,000 LB. LIFT CAPACITY, POWER SHIFT TRANSMISSION, and an unmatched 21″ GROUND CLEARANCE equip the 583 for heavy work in mountains or swamps . . . work that other machines can't handle over ground where other machines can't go. No wonder men who work with the 583 talk long and favorably about it.

For your own record-setting production *with low cost* . . . see your Caterpillar Dealer.

Caterpillar Tractor Co., General Offices, Peoria, Ill., U.S.A.

CATERPILLAR

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HEAVY-DUTY PIPELAYERS FOR THE HARD WORK

ft. is planned by K. A. Ellison and J. M. Huber. A 15,617-ft. junked hole in NE SW 10-12n-16w will be reentered for the test. Target will be the Hunton Siluro-Devonian.

Mobil Oil is considering a 17,000-ft. wildcat near Chitwood field in Grady County. The planned depth would be enough to test the Bromide Ordovician sands.

In Washita County at 20-8n-17w, the Humble 1 Schmidt is only a few hundred feet from its 17,000-ft. objective. A light gas show was reported in this well at 16,283 ft.

Conoco's ultra-deep Anadarko basin test, the 1 North Corn unit, is drilling below 3,000 ft. Target is 20,000 ft. If the well makes projected depth it will be the fourth in the state to touch 20,000 ft.

Conoco says Morrow-Springer, Hunton and Simpson sands are the big targets. Location is 19-11n-14w.

Another possible record buster is Gulf et al. 1 Tabor, 24-8n-15w. Now drilling below 6,900 ft., this wildcat is planned for 17,500.

New Terminal Has Deepest Channel in United States

A NEW Richfield Oil Corp. terminal with a channel deeper than any other in a U. S. port was dedicated recently at Long Beach Harbor.

The Pier E channel is 52 ft. deep, which is deep enough to service most tankers afloat. It got a critical test when the 71,000-ton Princess Sophie pulled dockside with its cargo of 506,000 bbl. of Middle East crude oil. In any other U. S. port, the Sophie would be forced to lighten part of its load before coming into the dock. The ship's draft is 44 ft.

The City of Long Beach spent $2,843,000 to deepen the channel to the terminal and Richfield spent $475,000 improving the terminal.

The Sophie is one of the largest tankers ever built in a U. S. shipyard. The vessel has a cargo capacity of 550,000 bbl. and is 837 ft. long. It is owned by the Niarchos interest.

The new terminal is located near the heart of Wilmington field—California's biggest with daily production of 75,000 bbls.

Fight Over Gasoline Tax Starts

THE BATTLE over the federal gasoline tax is under way in Congress.

The outcome is very much in doubt. From the House ways and means committee, where the verbal skirmishing began last week, the issue will still have to make its way through the House rules committee, a House floor vote, and be acted on by the Senate.

Administration forces are pressing for more revenue for the highway trust fund to enable completion of the vast highway-building program by 1972.

To do this, the administration wants to keep the gasoline tax at 4 cents a gallon instead of letting it revert to 3 cents as provided in 1959 legislation.

Also, it would hike the tax on diesel fuel and boost registration fees on heavy trucks.

Top administration officials, including Secretary of Treasury Douglas Dillon and Commerce Secretary Luther Hodges, argued before the House committee that such moves would be fair because the beneficiaries of highways—the users—would pay the cost of construction.

They said that using automotive excise tax revenue or money from the general fund would simply mean that other taxes would have to be hiked to replace that "lost" revenue.

And they said that the plan they propose would avoid costly deficit financing.

Industry logic . . . The oil industry found much fault with the line of reasoning used by administration spokesmen.

John Swearingen, president of Standard Oil Co. (Ind.), was one of the key spokesmen for the industry.

He represented the American Petroleum Institute, general Mid-Continent Oil and Gas Assn., National Petroleum Assn., Rocky Mountain Oil and Gas Assn., Western Oil and Gas Assn. and Western Petroleum Refiners Assn.

Jobbers and retailers also had representatives before the committee, as did the Oil, Chemical and Atomic Workers Union.

Swearingen's testimony, prepared for presentation to the committee late last week, included these points:

Only 2 years ago Congress specified that the 1-cent increase it was voting was temporary and the tax would revert to 3 cents on June 30, 1961.

Swearingen clearly implied that Congress should keep its word.

Furthermore, Swearingen hammered away at the fact that although the highway user was being singled out to pay the cost of the highway program, only part of the special highway taxes paid are credited to highways.

He noted that in the first 4 years of the new highway program the federal Government collected more than $14 billion in special taxes on highway users but only $8 billion of that was applied to the highway program. The other $6 billion went to the general fund.

Who benefits? . . . Swearingen quoted President Kennedy's highway message which states that the highway program is essential to national defense and makes "a vital contribution to our security, our safety and our economic growth."

Therefore, Swearingen reasoned,

INDUSTRY

Preventing underwater hull corrosion is the aim of a cathodic-protection system being tested on the tanker Esso Jamestown. Platinum anodes form the heart of the system, which keeps a potential of 0.85 volts on the hull.

Ashland Oil & Refining has acquired a second petroleum distributor company in the Auburn, N. Y.-Cayuga County area. Gormley Oil Co., independent distributor for Shell Oil for the past 25 years, is the latest purchase. Christopher & Wright, Inc., was an earlier buy. Gormley serves 20 stations in the Auburn area.

A petroleum-industry-exhibit building will be erected by Western Oil and Gas Association for Seattle's "Century 21 Exposition" which opens April 21, 1962. The associa-

in Congress

it would seem only fair that part of the highway cost should be borne by all taxpayers through use of some general fund revenues.

"At the very least, the special taxes highway users pay to the federal Government should be applied to the expense of this program," Swearingen said.

He also pointed out this bit of irony: Congress has condemned the diversion of highway tax revenues to non-highway purposes at the state level. And it has even threatened to withhold federal highway aid from any state that increases the proportion of funds that it diverts from highway uses to other state programs.

"Surely," said Swearingen, "the federal Government should abide by the same rule it lays down for the states."

Swearingen wound up his testimony by calling the committee's attention to the current level of state-federal gasoline taxes. They average 10 cents a gallon, or 48% of the average retail price.

"No similar necessary product is taxed at a rate even approaching that," he said.

He said ever-increasing gasoline taxes are having a highly undesirable impact on the motorist and on the industry.

Who should pay? . . . Swearingen emphasized that the industry favors good roads, but feels strongly that the proposed revenue plan is unfair.

He said the additional automotive excises alone would almost pay for the increased cost of the system—if these excises were earmarked for the highway fund as called for by 1959 act of Congress.

If more funds should be needed later, they should come from any other user taxes that are still being diverted to the general fund, or they should come from the general revenues of the government "in partial recognition of the broad benefits of highways extending beyond the actual users of the roads," Swearingen said.

Rivals Still Push LPG Lines

TWO COMPANIES planning rival LPG pipelines across southeastern states are going ahead with construction preliminaries.

If any backing down is contemplated, there have been no signs of it.

And there have been no indications that Trans-Southern Pipeline Corp. and its competitor, Dixie LPG Pipeline Co., might join forces to avoid duplication.

R. L. Topper, president of Trans-Southern, says his Houston-based company will send out specifications for construction bids in a few days. Trans-Southern is a subsidiary of Transcontinental Gas Pipe Line Corp. and will use much of Transco's right of way for its line from Mont Belvieu, Tex., to Sanford, N. C. (OGJ, Feb. 6, p. 87).

Topper says his company is buying other right of way and is making river crossings for its LPG line in conjunction with Transco gas-line-crossing projects.

Also, Trans-Southern has applied to the U. S. Corps of Engineers for authority to make pipeline crossings of the Trinity River, 10 miles south of Liberty, Tex., and the Sabine-Neches waterway in the Sabine River, 4 miles south of Orange, Tex.

Dixie, a Tulsa-based enterprise, has hired Service Pipe Line Co., Tulsa, to design and build a line from Mont Belvieu to Raleigh, N. C.

BRIEFS . . .

tion, which represents companies in six western states, says the exhibit will show how products of the petrochemical industry will affect life in the next century.

Michigan's crude-oil production climbed to 15,899,206 bbl. in 1960, the highest figure since 1949's 16,517,333 bbl. Last year's total was 5,460,598 bbl. above the 1959 level. The Michigan Commerce Department credits the Trenton development in the southern part of the state for the upturn.

New Utah fuel-regulation measures have been signed by Gov. George D. Clyde. One law requires retailers of motor fuels to post prices and discounts offered on dispensing devices and prohibits posting of prices on large signs. Another law removes benzol, butane, propane and similar products from the category of motor fuels.

Interest in 30 producing wells has been acquired by Texas American Oil Corp., Midland, from B. W. Wiseman, also of Midland, for an undisclosed consideration. Involved in the Permian basin purchase is a 20% working interest in 18 oil and gas wells and a royalty interest in 12 wells. Texas American estimates an additional 180,000 bbl. of oil and 335 million cubic feet will be added to its primary reserves.

Big savings in grease delivery are expected from a newly designed Humble bulk truck. First delivery from the new model has been made to the Midland, Pa., works of the Crucible Steel Co. of America. The $50,000 truck has three canister departments, each of 10,500-lb. capacity, with separate motors and pumps for unloading. The bulk system may be able to cut handling costs to almost half those of systems which use individual containers.

British American has been cleared of price-fixing charges raised last July during a price war in Toronto. Case against the company was dismissed after testimony showed that B-A had only asked two service stations to remove low price signs, as required by leasing terms, but that the operators were told that they could sell at any price they wished.

Purchase of certain U. S. and Canadian producing properties of Felmont Petroleum has been completed by Cities Service Petroleum. Included are 30,000 acres of leases producing about 4,550 bbl. of oil and 4,000 M.c.f. of gas daily. The properties are in western Kentucky, southern Indiana, the Texas Panhandle, and Ontario, Canada.

Model New Texas Field

Drillers Log 32 Straight Hits

THE NEW Arnold David field in the Corpus Christi area of Texas' lower Gulf Coast is setting a pace that will be hard to beat.

Here's the scoreboard for the 6-month-old field:

. . . Thirty-two good oil wells.

. . . A new well every 10 or 12 days.

. . . Seven rotary rigs in operation.

. . . No dry holes so far.

Arnold O. Morgan, an independent working in partnership with Southern Minerals Corp., opened the field last August. The partners, both of Corpus Christi, have 12 wells and two more are drilling.

Others in the play: Humble Oil & Refining Co., seven wells and two drilling; Sun Oil Co., eight wells and one drilling; Pan American Petroleum Corp., three wells and one drilling; and Texaco Seaboard, Inc., two wells and one drilling.

No limits fixed . . . The field, undefined by any close dry holes, now stretches more than 2 miles from its most northerly well to the most southerly one. It is more than a mile wide.

Significantly, the northernmost well—drilled by Texaco Seaboard—had the largest initial flow rate of any well completed so far. No water was evident and, with pressures and gas-oil ratio comparable with those of other wells in the field, this well gave no indication of the field's northern limit.

Arnold David lies in southern Nueces County, just off the southeastern side of the big Luby field and in a relatively narrow gap between Luby and the South Chapman Ranch field. Both of the latter fields are much older than Arnold David—Luby dating from 1937 and South Chapman Ranch from 1950.

At present the most westerly well in the new field is only 3,295 ft. from the nearest well on the southeastern side of Luby. Sun Oil, the operator, is drilling at a location about 900 ft. closer to Luby than

Arnold David's westernmost well.

On the south and southwest, the field has spread into the Chilipin portion of the King Ranch. Humble has drilled the most southwesterly well.

Top conditions . . . Near-model drilling conditions are found in Arnold David, which produces from the prolific Frio formation.

Three zones have proved productive.

The original and main zone, in which all wells have been completed up to now, is tapped at depths which have ranged from 6,060 to 6,090 ft. Average depth is 6,075-80 ft. This zone is designated as the Chapman sand.

Three wells have been completed dually. The second zone in two of these wells is the slightly shallower Eichelberger sand—a local name—which was perforated at 6,056-61 ft. in one well, and at 6,052-56 ft. in the other. The second zone in the third dual well is a 5,600-ft. sand, only lately tested.

All wells are flowing. All come in at flow rates which have averaged 136 bbl. daily through small chokes, mostly 7/64 in. or 8/64 in.

Except for the northernmost well, which flowed 216 bbl. daily through 8/64-in. choke, flow rates have ranged from 114 bbl. to 176 bbl. daily. Most have been close to the field average.

Gravity of the oil has run from 41° to 42° API.

Flowing pressures range from 560 to 1,750 psi., averaging 1,020 psi. for the 32 wells. With few exceptions, gas-oil ratios are under 900 cu. ft. per barrel.

The Texas Railroad Commission has been asked to set up rules on drilling and production. Operators concur in recommendations for 330/933-ft. spacing of wells to the same reservoir with 40-acre proration units.

Sinclair Providing Anadarko Basin Outlet

CRUDE-OIL producers in the North Anadarko basin area will get a new outlet when a pipeline system is put together by Sinclair Pipe Line Co. Work on the project, to cost $6,000,000 or more, is to start immediately.

Part of the system will be made up of existing lines in the area. These will be connected to Sinclair's main line in Central Oklahoma, making North Anadarko crude available to refiners in the Houston, Wood River, Ill., and Chicago areas.

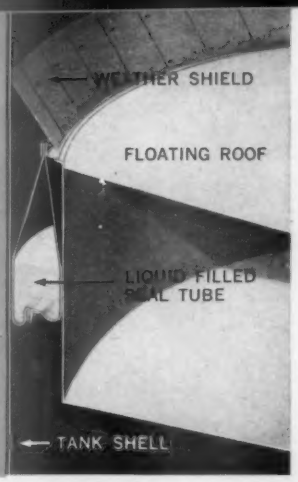
Sinclair is buying the 45-mile, 6 and 8-in. Wheat Belt line which connects Laverne station in Oklahoma with the Jayhawk pipeline at Harper Ranch terminal in Kansas.

Sinclair is also purchasing the gathering system of Cameron Crude Oil Corp. in the Laverne-Stockholm-Buffalo areas of Harper County, Oklahoma. Cameron also owned Wheat Belt. Cameron will continue as a purchaser in the area.

A 170-mile, 8-in. line will be built to connect the gathering system with Sinclair's main north-south line about 40 miles east of Oklahoma City. It will have a capacity of 10,000 bbl. per day.

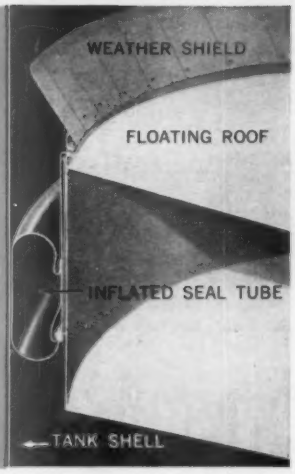
SR5 / HORTON
LIQUID FILLED FABRIC SEAL

- Sealing liquid holds envelope against tank shell.
- Pressure against shell is greatest at bottom, decreasing to zero at top of contact.
- Flexible ring support provides adequate clearance and better fit for all rim space variations.
- Sealing band and rim band vulcanized at bottom connection.



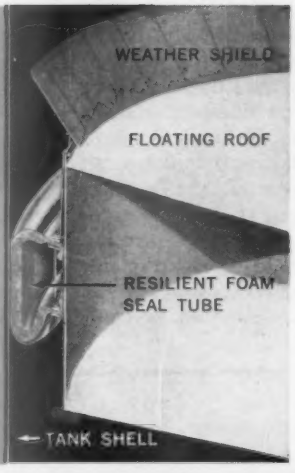
SR6 / HORTON
INFLATED FABRIC SEAL

- Gas holds envelope against tank shell.
- Constant mild pressure, maintained by simple gasholder, over entire surface.
- Positive means of supplying seal gas.
- Maximum clearance to accommodate rim space variations due to badly out-of-round shells.
- Vulcanized to form endless tube.
- Can be serviced from top of roof.



SR7 / HORTON
RESILIENT FOAM FABRIC SEAL

- Resilient foam holds envelope against tank shell.
- Mild and positive pressure against tank shell.
- Maximum clearance to accommodate rim space variations due to badly out-of-round shells.
- Endless sheet covers resilient foam, forming tight envelope.
- Can be serviced from top of roof.



SR3 / HORTON
METALLIC SEAL

- Continuous steel sealing ring.
- Pantagraph hangers hold sealing ring against tank shell with minimum pressure.
- Hangers keep roof centered in tank.
- Continuous seal closes rim space.

Widest Choice of Seals for Floating Roof Tanks

Because CB&I seals so successfully reduce evaporation, retard corrosion and minimize fire hazards, more CB&I floating roof seals are in use than all other designs. Four of the most popular CB&I seals are illustrated here. CB&I offers the widest selection. Talk over your requirements, for new or existing tanks, with CB&I. The most efficient design for your installation will be recommended.

CB&I's extensive experience (since 1922) with all types of sealing designs is at your disposal

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CORE SAMPLE of new sediment on floor of Gulf of Mexico is taken by Pan Am scientists to help form a picture of ancient oil-bearing sediments which are now buried.

New Sediments May Help Pan Am Find Ancient

MERLE BLAKELY
District Editor

SCIENTISTS of Pan American Petroleum Corp. are well along in an intensive study of sediments in the Gulf of Mexico.

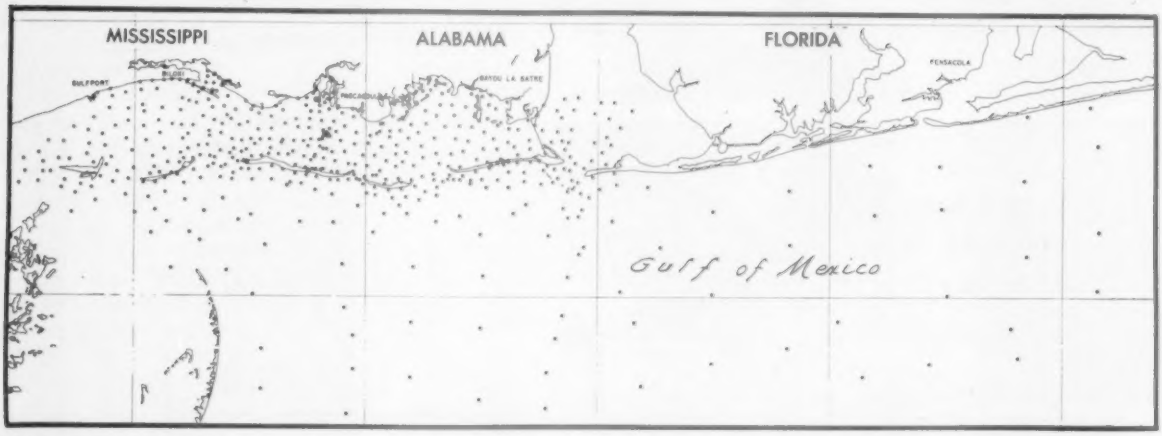
The object: Learn everything possible about sediments now being laid down in order to know more about oil-bearing sediments lying far below the earth's surface.

They are systematically taking samples from the floor of the Gulf of Mexico, from the Louisiana Delta area to the west coast of Florida and seaward as far as 100 miles. They're also taking samples from rivers which pour into the Gulf.

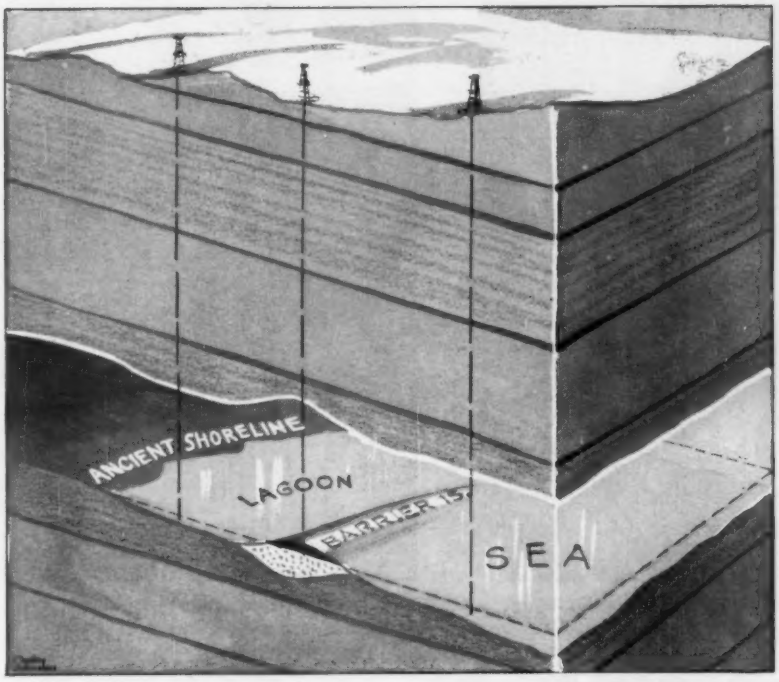
By painstaking study and correlation over a period of time, the scientists expect to be able to form a picture of the composition of the Gulf sediments which can be compared with long-buried beaches, shorelines, sand bars, rivers, deltas, and bays.

So, when a core is cut in a wildcat in New Mexico, Pan Am's scientists will, by examining its sand grains, pollen fossils, and other aspects, be able to say, for example, that it was laid down a certain distance from an old shoreline—and in which direction the shoreline is.

Ability to identify a shoreline is



SITES where some sediment samples were taken in the Gulf of Mexico.



RESEARCHERS EXPECT sedimentcores taken from the bottom of the Gulf of Mexico, and rivers flowing into it, will help them find ancient shorelines which point to traps for oil.

With the information being compiled about current sediments, Pan Am hopes to be able to determine buried geographical landmarks by examining the sand grains, pollen fossils, etc. of well cores.

This would give them a picture similar to the one shown.

Oil-bearing Sands

important because old shorelines form ideal traps for oil.

With this type of information, the exploration department would be able to spot the next location with a greater chance of finding production.

About 1,200 samples have been taken in the last 13 months, and the sample-taking program will continue into this summer.

Intensive studies of bottom specimens are being made by teams at Pan American's research center in Tulsa, and early results show promise that the knowledge will help find oil.

Eventually, researchers hope to be able to plot a beeline to a strat trap by interpretation of minute sand textures and grains and relating the information to strata laid down millions of years ago.

Advantageous site . . . Why did Pan American elect to concentrate its studies in waters of the Gulf of Mexico? And more specifically offshore from Mississippi, Alabama, and the Florida Panhandle, and in rivers draining these states?

The big reason is that it's an area where a continuous picture of earth strata can be examined. This is not possible in analyzing cores from wells because of broad gaps in between.

"We have a continuous pattern, we feel, in the gulf extending about 130 miles from Mississippi sound, near the Mississippi-Louisiana line, east to the northwest coast of the Florida Peninsula," one Pan American scientist explained. The gulf study area alone approximates 6,000 sq. miles.

The strata or layers of sediments laid down by water on the continental shelf never are completely level or uninterrupted. They vary considerably, due to interrelated action of currents, barriers, storms, supply of sediments and organisms.

"We try to plot the high and low places, channels and bars, the degree of salinity, distribution of animals, and other features with accuracy," a researcher said.

"Knowledge of environment of deposition is important in interpreting how formations were laid down in reservoirs where oil now is being produced, and where drilling is underway."

River cores also relate to distribution and deposition of sands and organic matter at river mouths in the gulf. This gives the micropaleontologist another dimension to ponder in analyzing why sands are laid down as they are when river waters meet gulf currents.

Studies of sands in the gulf and in other waters have been made over a period of many years by oil companies and by research organizations. But some have been purposely restricted in area; others have been aimed at single and specific targets.

Project leaders say Pan American's work to date represents one of the most concentrated gatherings of evidence in the gulf area ever undertaken.

Four-way study . . . Every one of the underwater specimens is being examined from four different approaches:

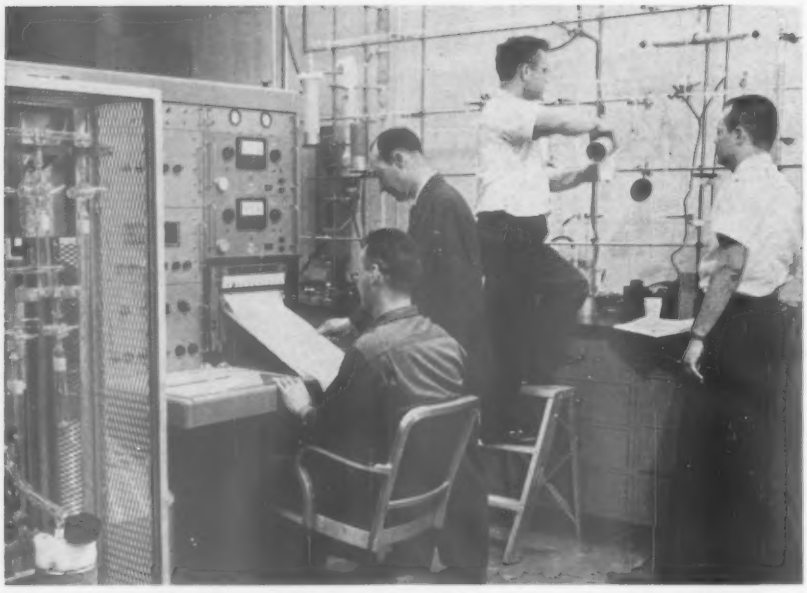
. . . Microscopic and other petrographic examination is made of the sands and clays in undersea cores to determine size, textures, mineral compositions, and their distribution patterns.

. . . Isotope analysis is done on the organic carbon.

. . . The micropaleontology group investigates the shells of the smaller living organisms.

. . . The palynology section checks the spores and pollen and certain

STORED sediments are kept in stoppered plastic tubes.



PART OF STUDY of sediments includes checking the weights of the chemical elements in a mass spectometer.

algae and algal-like organisms.

The entire project is under supervision of Richard S. Tremaine, head of Pan American's geological division in the Tulsa research laboratory.

"We want to learn relationship of the characteristics of sediments, establish these in terms of distinct patterns or critical values which may be characteristic of certain environments, and apply the lessons we learn to the ancient sedimentary rocks where company geologists are exploring for oil today," Tremaine said.

From reading the samples, Pan Am scientists believe they may reconstruct the makeup, the direction, and other characteristics of old shores, inlets, beaches, and deltas.

By checking grains of the sediments, the researchers may tell if a sand revealed in a well core was laid down as a dune, river or beach deposit.

This ability is a significant extra tool for petroleum geologists. It will help these subsurface detectives spot buried shorelines or reefs where oil may accumulate and thus nail down better drill sites.

How they core . . . Two large boats were rented to do the Gulf of Mexico work. They were trawlers and carried intricate equipment for core collection.

Coring devices with stainless steel barrels and plastic liners were pitched overboard. They were weighted to take them 2½ ft. into the bottom muds and silts. A screen flange kept core depths uniform.

Salinity and bottom water temperatures were checked as each core or grab sample was taken, and pulled to the surface. The specimens were obtained in water depths from 10 to 480 ft.

River parties have done similar work from small boats along the Pearl, Chickasawhay, Tombigbee, Alabama, Choctawhatchee, and the Flint rivers. Other parties now are getting samples from the Suwanee, Appalachicola, and other nearby rivers.

Samples of each core taken have been isolated and identified again in one-gallon glass jars and smaller bottles at the laboratory. Slides have been prepared. They will be available for study for years. Chemicals have been used to prevent deterioration, and chemicals have been selected which would not affect original quality of the sands.

Ultimate gains . . . Pan American is tackling its ambitious project along tried and proven lines—using the present to decipher the past.

It also hopes to gain new information which can be used more specifically to identify conditions found in today's successful petroleum exploration.

As final results are obtained, the data will be passed along to company exploration geologists. This will be in company reports and seminar-type training sessions to be conducted at the research center by the research men who actually conducted the studies.

By all this intense research, Pan American hopes to trim further the element of chance in finding oil.

PIPELINE

Contracts for two large projects will be let soon by Mustang Fuel Corp. One involves 75 miles of 4½ to 12¾-in. line from Piedmont, Okla., to Oakwood. The other involves 17 miles of 10¾ to 12¾-in. line from Newcastle, Okla., to Crider. Both projects are scheduled for completion in June.

Tennessee Corp.'s plant near St. Petersburg, Fla., will be tied into the Houston Texas Gas & Oil Corp.'s natural-gas system by a 16-mile 14-in. lateral to be laid before June 1. Burnup & Sims is the contractor.

More than 10 miles of gathering lines will be laid in Oklahoma and Kansas by Panhandle Eastern Pipe Line Co. The program calls for

Fuel-Oil Industry Launches Comeback Program

• Seeking to recover ground lost to gas and electricity, industry earmarks $1 million for research on new and better heating equipment, appliances.

THE FUEL-OIL industry, harried by gas and electrical competition has launched a massive program to regain lost ground in the home-heating market.

It gives all the evidences of acting and thinking like a growth industry again.

This was apparent last week when oil-industry research men and technical representatives of equipment manufacturers met in Chicago to discuss a research program on distillate-fuel combustion.

Researchers hope the eventual result will be better and cheaper home-heating equipment plus new oil-fired appliances like water heaters, incinerators, and air conditioners.

A. J. Rumoshosky, director of the API division of refining which is coordinating the research program, told the conference that the industry is pooling resources and manpower to save and expand the fuel-oil market.

He said refiners have a new appreciation of the importance of fuel-oil sales to their economics.

Scope of program . . . A $1-million yearly cost tag was put on the research program by V. A. Bellmon of Mobil Oil Co., API vice president for marketing.

He reported oil-company research teams will investigate some of the problems in their own laboratories. Other specific projects will be contracted to university researchers.

The studies will involve the characteristics of fuel oil, effects of spray-droplet size on combustion, new means of atomizing or vaporizing fuel, new ignition systems, and all aspects of burner performance.

Data will be relayed to the equipment manufacturers who can use it in designing new home appliances.

Bellmon stressed that both the fuel-oil and the equipment markets are important.

He said the value of fuel-oil sales last year exceeded $2 billion and should show a 40% growth in the next 10 years, and added that the replacement market alone in this decade will call for nearly 5 million new home-heating units.

"It's not a dying market nor one that you just let slip through your hands," he declared.

Selling problem . . . New approaches to marketing fuel-oil also will be made in connection with the research program.

T. J. Scott, largest independent fuel-oil marketer in Massachusetts, said the key to keeping present markets and expanding into new homes is making efficient equipment available at the lowest possible price.

Other speakers said better-performing equipment and more service to customers by dealers could help take fuel customers from competing fuels.

G. L. Werly, retired Mobil marketing executive who recently was named director of the new National Oil Fuel Institute, summed up the feeling of many when he said the fuel-oil industry is putting its house in order for a fight for markets.

"Progress only comes through periods of stress and strain like these when competition forces us to act," he said.

BRIEFS . . .

3.85 miles of 4-in. line and 3.44 miles of 6-in. line in Oklahoma, and 1.87 miles of 4-in. line and 1.01 miles of 6-in. line in Kansas.

A 22.37 mile 24-in. junction line between Magnet-Withers and Missouri City in Fort Bend County, Texas, is planned by United Gas Pipe Line Co. Completion is due early in May.

FPC fell further behind in its backlog of construction applications in February, an end-of-month report shows. As of February 28 there were 193 applications on file for 6,761 miles of pipeline and 601,990 hp. in compressor stations. Total estimated cost: $851,643,433. At the end of 1960, there were 186 applications involving 5,783 miles of line and 464,300 compressor hp. at an estimated cost of $698,647,557.

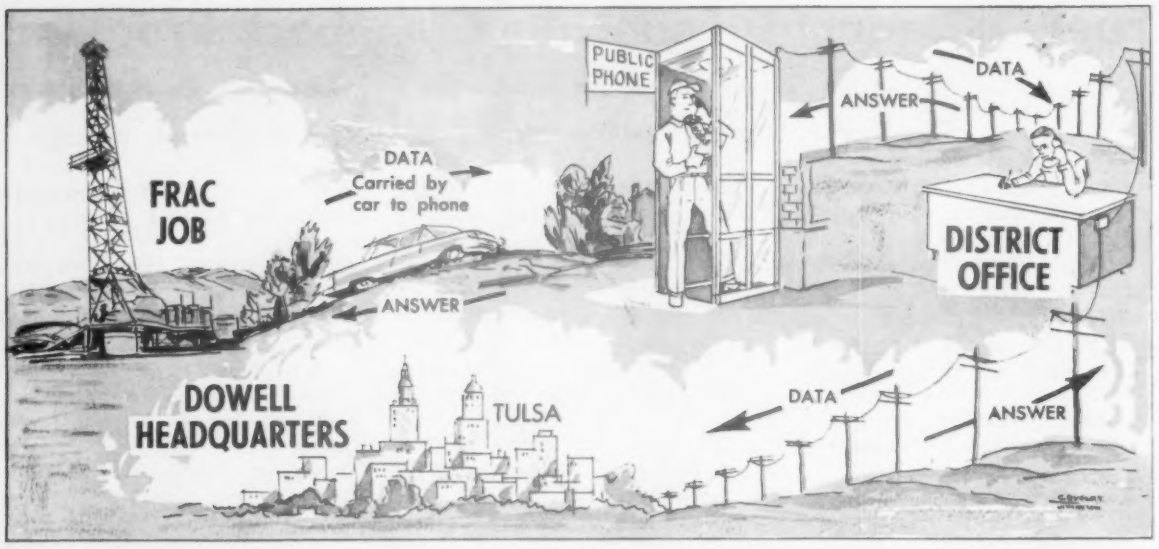
New projects planned by Lone Star Gas Co. include a 51.2-mile 18-in. transmission line from Parker County to Palo Pinto County, Texas, and these gathering lines: 6.3 miles of 16-in. line in Erath County, 16.5 miles of 8-in. and 11.6 miles of 6-in. line in Palo Pinto County, 23.3 miles of 8-in. line in King County, and 7.6 miles of 8-in. line in Smith County. Plans also call for laying 14.5 miles of 8-in. line in Carter County, Oklahoma.

Work has begun on a 52-mile 12-in. line from Lone Star's Gordon, Tex., plant to Springtown, Tex., where it will tie in with the main line to Dallas. The line, to be finished in mid-May, adds 100,000 M.c.f.d. to Lone Star's supply. Cost, including 2,000 hp. in compressor capacity and new extraction facilities at Gordon, will be $3,000,000.

Phillips Petroleum will market propane from the seven terminals on the Northern Gas Products-Great Lakes LPG system as soon as the system goes into operation.

A total of 448 miles of pipeline will be laid by Tennessee Gas Pipeline Co. this year if FPC approves all projects. The company plans 124.9 miles of 8 to 16-in. gathering lines and 324 miles of 30 to 36-in. loop lines. FPC has okayed 47.9 miles of the gathering lines and 158 miles of 36-in. loops.

Crews have begun work at both ends of the 500-mile 12-in. crude line of Western Pacific Products and Crude Oil Pipelines, Ltd., which will go from Taylor to Kamloops, B.C. (OGJ, Feb. 13, p. 58.)



Computer Cuts Fracture-Calculation Time

- Machine does in 10 minutes a job usually done by an engineer in a full day.

Dowell engineers now pick up the closest phone, then stand by for directions.

FRACTURE-treatment engineering is now being done by electronic computers.

And a complete investigation of a proposed fracture treatment can be done in about 10 minutes. Normal time for one engineer to do the same job is 8 to 10 hours.

Dowell Division of Dow Chemical Co. expects to offer this fast service soon from all of its district offices, through the field engineers.

Dowell engineers say the new system will permit them to make better recommendations for fracture treatments. There are several reasons for this:

. . . More accurate calculations. Hand calculations are laborious, tiresome, and subject to errors.

. . . Greater speed. Even with a well in a remote area, time needed is cut drastically.

. . . More complete program. Three fracturing fluids are examined, and all variables can be plugged into the final answer.

. . . Closer approach to optimum treatments. By using all available data, a better job can be done, resulting in a faster payout and in increased production after payout.

. . . Better reevaluation. Wells already fractured can be studied with the new setup and the production data compared with the treatment used. Idea here is to improve technology in order to make future predictions more reliable.

First application of the computer solution of Dowell's Frac-Guide was made in the Denver area on a Bendix G-15 computer. Initial successes started the wheels rolling, and now Dowell is working with a Tulsa computing service to put the service on a nation-wide basis.

An Alwac III computer is being programmed to produce the answers within 10 minutes.

Three determinations are made for each of the three fracturing fluids under consideration. These are made to see whether the fluid is viscosity-controlled, reservoir controlled, or wall-building for the particular formation involved.

Evaluations are made on the basis of the amount of fracturing fluid, amount of propping agent, rate of injection into the formation, and pressure needed.

Computer output shows predicted increase in production, cost of treatment, and payout. From this information the operator may select the treatment which is best for his well.

If it is found desirable to evaluate more than three fluids, the program can be run again—in another 10 minutes of machine time.

How it works. Every derrick floor is as close to the computer as the nearest telephone.

The Dowell field engineer collects the data on the well. He drives to the nearest phone and sends the data to his district office, and from there it goes by teletype directly to Dowell's Tulsa office.

The data is fed into the machine, and minutes later the results are on their way back to the district office by teletype for relaying by phone to the Dowell field engineer.

And all of this can be done in less than 2 hours if time is critical.

Small-Tract Bill Offered

A BILL submitted to the Texas legislature last week aims at softening the blow dealt to small-tract drilling by the state's Supreme Court.

The bill, introduced by Rep. Stanley Boysen, Yoakum, would require the Texas Railroad Commission to base gas-allocation orders at least one-third upon the number of wells in a field.

Earlier this month the Supreme Court, in a landmark decision involving gas proration in Normanna field in Bee County, upset a similar order (OGJ, Mar. 13, p. 100).

Sour Note Mars Iran's Celebration

• Tenth anniversary of oil-industry nationalization finds Iranians still pleased over their expulsion of the British. But there's more and more grumbling about their fall to third place among Middle East oil nations.

Paul Swain
International Editor

WITH mingled feelings of pride and disappointment, Iranians this week are celebrating the tenth anniversary of the day they threw the British out of their oil industry and took it over themselves.

Iran is still proud of nationalization, although the oil industry views it as a misguided experiment.

But even as they celebrate, Iranians are grumbling because their oil-producing operation is no longer the biggest in the Middle East. Iran held that distinction when nationalization was rammed through.

The Iranians blame their decline on the group of American, British, Dutch, and French oil men who salvaged their industry in 1954.

In fact, relations have never been quite so strained as they are today between Iranian oil officials and the international Consortium which operates the country's oil industry.

The celebrations throughout Iran this week point up the fact that when Mohammed Mossadegh, then premier, ousted Anglo-Iranian Oil Co., he proudly proclaimed that the oil was Iran's.

Technically, this is still true. But the thing that most celebrating Iranians forget—or choose to ignore—is what happened to the industry after Mossadegh's action. For 3½ years the Iranian oil industry very nearly went to pot.

Mossadegh, who was addicted to pajamas and public weeping, watched with increasing dismay as oil production slid to almost nothing. As the leader of a soverign nation, he could take over the industry but he couldn't take over the markets for oil.

Prospective buyers for the crude which Iran offered found themselves harrassed by British legal claims in courts throughout the world.

In 1950, the year before Mossadegh's action, Iran was producing 665,000 bbl. of oil daily—by far the largest output of any oil-producing country in the Middle East. In 2 years, production dwindled to less than 28,000 bbl. daily.

Comeback was hard . . . The climb back up the ladder has been a laborious one.

Western oil men reentered the country in October 1954 under a complicated agreement. They were to operate the industry for Iran through a contractual agreement. The oil was to be Iran's. The two operating companies set up by the Consortium technically were, and are, working for National Iranian Oil Co.

Under this setup it took 3 years for Iran's production to reach the 720,000-bbl.-daily level. By that time, Saudi Arabia and Kuwait fields had long passed Iran. Both were busily supplying markets that had once been Iran's.

Now, when Iranian production tops a million barrels of oil daily, both Saudi Arabia and Kuwait can easily produce 50% more than that—and frequently do.

The national oil company has been of some comfort to Iranians. It has handled oil-product distribution in the country, has built a growing network of product pipelines and has found some oil and gas on its own. In addition, NIOC has entered into partnership exploration deals with both Italian and American companies.

Iran's happiness over NIOC developments is one of the props of this week's celebrations.

Discontent with Consortium . . . Aside from the fact that proud Iranians don't like being in third place in the Middle East, there is increased grumbling in Tehran about nearly all phases of the Consortium's operations.

Here are some of the most frequently heard complaints:

. . . Basic policy decisions of the two Consortium operating companies are made without the Iranians' having any sayso whatever.

. . . Low level of exploration drilling does not satisfy Iranians, who are in a hurry to see their country regain the producing spot it once held.

The Consortium has only one wildcat rig active at present. This is testing an oil show encountered in a deep test of the long-established Pazanun gas field.

The only other wildcat rig being operated by the Consortium is now being moved from Suru 1, a 14,895-ft. dry hole drilled near Bandar Abbas in the extreme southern part of Iran. This rig will be used for a new wildcat test on Shaik Shuaib Island, 200 miles to the west along the Iranian coast.

. . . Low production levels. The Iranians believe that present fields and production facilities operated by the Consortium are being held back because the members of the Consortium prefer to produce properties they own or control in other countries.

. . . Too few Iranians are being trained to take over jobs now held by foreigners. Iranians charge that the expatriate employes of the Consortium—most of whom are "on loan" from the companies which

Italians Ship First Persian Gulf Oil

THE FIRST 150,000 bbl. of Italian-produced Persian Gulf oil is on its way to Italy.

The tanker "Cortemaggiore," named for one of mainland Italy's few producing regions, sailed last week from the permanent platform built by the Italians in the Persian Gulf just 7 miles off Iran's coast.

Aboard the tanker was the crude output from tests made on the first well drilled by the Italians under controversial 75-25 profit-split deal. The deal was made with Iran in exchange for offshore concessions.

Drilled from a permanent platform erected by Societe-Irano Italienne des Petroles (SIRIP), the well was spudded in August 1959. Results were kept under wraps until a few weeks ago when Enrico Mattei, Italy's oil man-politician, disclosed that the well is capable of producing at the rate of 3,500 bbl. daily.

A second well, drilled from the same platform, was fishing for stuck pipe at 7,050 ft. last week.

have an interest in the operation—are too highly paid and, in addition, are holding jobs that could be performed by Iranians.

This, plus Iran's third ranking as a Middle East producer, apparently rankles the Iranians more than any other real or imagined slight on the part of the Consortium. Many Iranians are now talking about the "forcible" departure of western employes of the Consortium and their replacement by Iranians.

All these grievances, whether justified or only imagined, are voiced by some pretty highly placed Iranians with ever-increasing frequency.

For example:

"Unhappily, it is obvious that the oil companies raise production in a definite country for one of two reasons: Either for commercial interest or under political blackmail. That is why Iran feels neglected."

The speaker was the Shah of Iran.

"Our wish is to see the number of expatriates drastically reduced in the very near future, while production should soar to give Iran first place in the Middle East."

The speaker was Abdullah Entezam, chairman of NIOC.

"We are determined to put as much pressure as we can to attain our two aims — more production and faster 'Iranization' of the oil industry."

The speaker was A. A. Hoveyda, a director of NIOC.

NIOC achievements . . . The national oil company, which regards the two operating companies of the Consortium as its subordinates, has a number of ultimate goals. Some are being accomplished in a greater degree than others.

NIOC's first duty, according to its official statements, is to make certain there is an adequate and regular supply of products to meet Iran's rapidly rising oil consumption. This the national company can achieve by calling upon the output of the Abadan refinery, the world's largest before it was nationalized and left virtually idle for more than 3 years.

To achieve its first aim, NIOC must distribute products over the consumption areas of Iran. Product pipelines have been built to relieve other transport facilities, and NIOC has budgeted about $118 million for the next 5 years to keep pace with the distribution problem.

Iran's internal demand is expected to reach 100,000 bbl. daily by 1964.

Exploitation of reserves found by NIOC at Alborz and Sarajeh are high on the "must do" list for the government company.

Construction of a refinery in the Tehran area to operate on crude from these two Central Iran fields is in the cards.

A pipeline from Sarajeh to Tehran is under study to make use of the gas supplies available from this gas-condensate field. NIOC estimates that Sarajeh has reserves of 7 trillion cu. ft. of gas, plus 400 million barrels of condensate.

At Alborz, 85 miles south of Tehran, NIOC is still trying to develop an oil field capable of being produced from a formation which furnished the oil world one of its most spectacular blowouts and fires in 1957.

The company is now testing what may be the first commercial well of eight drilled on this structure. A ninth test is drilling below 2,300 ft.

In the matter of its partnership awards of concession acreage to the Italian Government-owned AGIP Mineraria and Pan American International, Iran is still waiting for concrete productive developments.

SIRIP, the Italo-Iranian company, has established production in the Persian Gulf off Iran and is now drilling a second well.

IPAC, the Pan Am-Iranian venture, now has two deep wildcats in the testing stage to determine whether commercial oil fields will be established off the coast of Iran.

Bidding Spirited in Libya

. . . for acreage surrendered by companies under terms of country's oil law. Interest highest in Tripolitania.

LIBYA has sparked a flurry of bidding action by opening some of the country's choicest acreage to reallocation.

The Petroleum Commission is accepting offers for exploration rights on areas surrendered by other companies under terms of the Libyan oil law. This specifies that 25% of every concession must be turned back to the government after 5 years.

Within hours of the Petroleum Commission announcement, three companies submitted bids—in some cases on duplicate acreage.

Initial bidders included Phillips Petroleum Co. of Libya, which so far holds no acreage in the country. The others, Pan American Libya Oil Co. and an Italian firm, Cia. Richerche Idrocarburi (CORI), hold licenses but have no discoveries.

The open acreage covers a total

of 50,000 sq. km., or about 19,300 sq. miles, most of it in the northern part of the country.

While the acreage involved was relinquished in November by earlier concession holders, much of it has been scantily explored and is near existing finds.

Interest is concentrated so far in Tripolitania, which covers the northwest quarter of the country.

Duplicating bids have been submitted by Phillips and CORI on acreage relinquished by Oasis Oil in Block 26 in western Libya. Oasis has drilled two 500-bbl.-daily wells on the portion of acreage it retained.

Duplicating bids also have been submitted by Phillips and Pan American on Concession 11B in the north-central part of the country. The tract lies southeast of four Mobil wells in Block 11 acreage retained by the company. Wells test from 265 to 1,500 bbl. daily.

Phillips and Pan American also have submitted duplicating bids on Block 25A northwest of Mabruk field on Block 17 in Central Libya.

Other open acreage sought by Pan American includes tracts 20A, 47A, 13A, 12A, and 6A (east).

The latest figures issued by the Petroleum Commission show why interest remains high. As of March 1, oil play which started in 1955 had resulted in 225 completed wells. Seventy-eight are oil and six are gas producers.

The oil producers have a combined production potential of 136,830 bbl. daily.

Yugoslavia Expects to Make Big Oil Gains

YUGOSLAVIA is coming into its own as an oil producer and refiner.

This doesn't mean it is going to rival the Middle East as an oil source. But the Adriatic country is beginning to point with pride at its petroleum milestones and to aim at new ones.

In 1960 Yugoslavia registered a whopping 46% increase in domestic production and a 9% increase in refined-product output. And oil imports dropped 15%.

This year Yugoslavia is shooting for a daily oil production of at least 28,000 bbl. — more than double the 1959 output—and is about ready to break ground for a new 24,000-bbl.-daily refinery. All this and more is needed to keep pace with the rapidly increasing oil demand in the country.

Exploration success . . . It was a long time coming, but Yugoslavia is now counting on a daily production of at least 12,000 bbl. from its newly established — and biggest — oil field at Struzec.

The east-west asymmetric anticline of Struzec has been known since before World War II, and general exploratory activity was carried out both before and after the war.

It wasn't until 1957 that Naftaplin, Zagreb-based company, was able to confirm the seismic and gravimetric work done in previous years.

Naftaplin first started producing the 40° - gravity, sweet crude at Struzec in May 1960. Now that more than 60 wells have been drilled on the structure, production is beginning to make itself felt in the country.

The deepest test of the structure went below 8,000 ft. but the producing wells are no more than 3,200 to 3,300 ft. They produce from a Lower Pliocene sandstone which is as thick as 475 ft. in some wells.

Naftaplin expects to drill another 80 wells on the structure before the field is fully developed. The company estimates the Struzec reserves at a minimum of 100,000,000 bbl., on the basis of current drilling.

The new oil find is only 10 miles from the 6,000-bbl.-daily refinery at Sisak.

New refinery plans . . . With Yugoslav demand increasing every year and more production being established all the time, the country's three small refineries are hard-pressed to keep up with the consumption of oil products.

Earthmoving operations for a new 24,000-bbl.-daily refinery near Pancevo are slated. The new plant will be only 10 miles from Belgrade on the east side of the Danube. Completion is due in mid-1964.

The new refinery will be supplied by fields in the northeastern part of the country. Supplies will come from old fields and from new reserves which are only beginning to be developed.

The fields of Elemir and Aradac, containing at least 20 wells, produced about 8,000 bbl. daily last year. Another 4,000 bbl. daily can be supplied by the older fields at Boka and Jermenovac. In addition, the Novi Sad reserves being developed by Naftagas accounted for 4,000 bbl. daily last year.

The big hope for a supply for the Pancevo refinery is the new field now being drilled at Kikinda about 60 miles north of the refinery site.

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Beginning:
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Try molecular sieves for

Successful sweetening of natural gasoline

BY KENNETH H. BACON
Warren Petroleum Corp.
Tulsa

AND

ALFRED M. HENKE
Gulf Research & Development Co.
Pittsburgh

NATURAL GASOLINE can be desulfurized and sweetened by cyclic adsorption and regeneration using 13X molecular sieves. Factors affecting the design and operation of the adsorption part of the cycle include sulfur content, temperature, space velocity, and column design.

Sulfur content can be reduced to meet rather stringent specifications. Preliminary results indicate the process is noncorrosive and commercially feasible.

How it Works

A schematic flow diagram for the adsorption step in the new process is shown in Fig. 1. In this study, the adsorber columns were 2.1 in. i.d. with lengths which varied from 24 to 41 in., and these were packed with dried ⅛-in. 13X molecular sieves. The deethanized natural gasoline was charged to the top of the column and flowed down through the molecular-sieve bed. The percolated gasoline was distilled into chosen fractions comprising propane-butane, isopentane, and n-pentane and heavier.

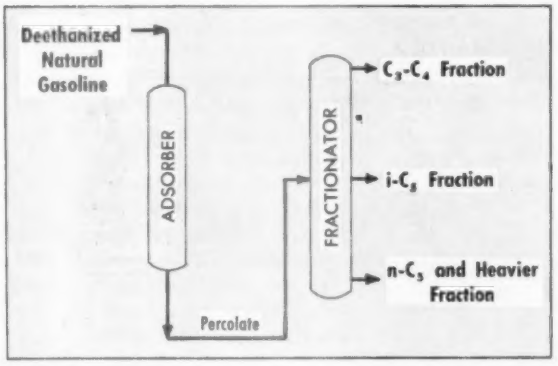
These distillations were done batchwise in a 60-plate (total reflux) Hyper-Cal column at a 20:1 reflux ratio. Although not a limitation to the process, maximum sulfur specifications for the component fractions were set as shown in Table 1. Fractions which met the set sulfur specifications were all found to be doctor sweet.

Two deethanized gasolines were used in this study, and these varied

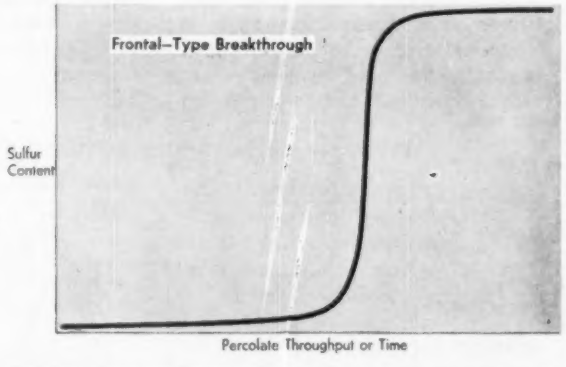
TABLE 1—SULFUR SPECIFICATIONS

Natural-gasoline fraction	
C_3—C_4	3.0 p.p.m. total sulfur (maximum) or 0.3 grain/100 s.c.f. (maximum) and noncorrosive
iC_5	3.0 p.p.m. mercaptan sulfur, doctor sweet and noncorrosive
nC_5 and heavier	3.0 p.p.m. mercaptan sulfur, doctor sweet and noncorrosive

Paper presented at NGAA annual meeting, Dallas, 1961.



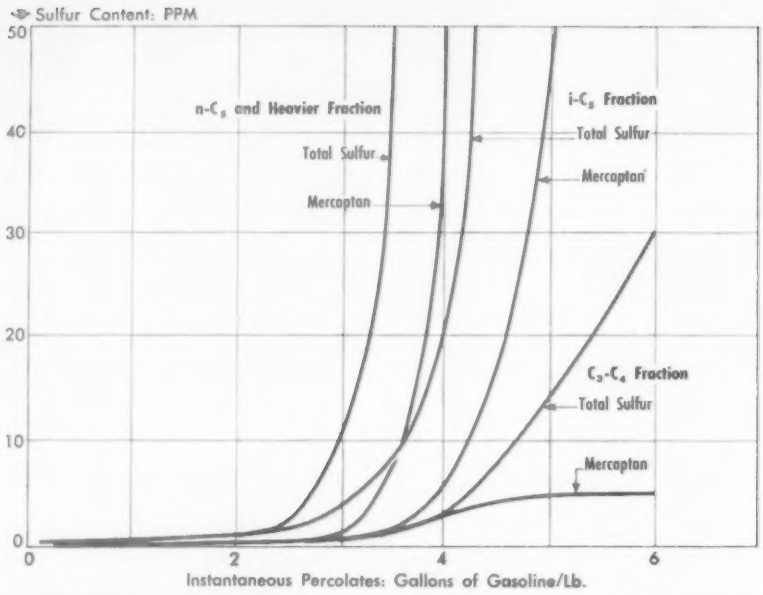
FLOW PATTERN for sweetening process involves passing deethanized natural gasoline through an adsorber and then fractionating the product. Fig. 1.



FRONTAL-TYPE BREAKTHROUGH is must if sulfur compounds are to be removed to meet stringent sulfur specifications. Fig. 2.

greatly in sulfur content as shown in Table 2. Gasoline A contained 885 p.p.m. sulfur which was predominantly mercaptan, 746 p.p.m. The sulfur content of the propane-butane fraction was solely mercaptan indicating the absence of hydrogen sulfide. Gasoline B contained over twice the sulfur content, 2,265 p.p.m., of Gasoline A with nearly equal amounts of mercaptan and nonmercaptan. The propane-butane and the n-pentane and heavier fractions contained nearly all of the nonmercaptan sulfur.

A Podbielniak distillation of Gasoline A showed that the propane-butane fraction contained 3.3% ethane; and that the n-pentane and heavier fraction contained 34% hexanes, 16.3% heptanes, 13.5% octanes, and 0.7% nomanes. Thus, the gasolines had a wide boiling range as well as a great variation in sulfur content and types.



SULFUR CONTENTS of instantaneous percolates when charging high-sulfur-content gasoline B to small adsorption column. Fig. 3.

Equilibrium loading. The equilibrium loading of Gasoline A (885 p.p.m. S) on 13X molecular sieves was measured at 100° and 375° F., at 350-psig. pressure. At 100° F. this loading was 3.4 lb. of sulfur per 100 lb. of molecular sieves or 9.5 lb. of sulfur—containing compounds per 100 lb. of molecular sieves. At 375° F. only 2.6 lb. of sulfur-containing compounds was adsorbed per 100 lb. of molecular sieves.

The literature[1] has shown the equilibrium loading of H_2S from a propane stream containing 1,000 p.p.m. sulfur to be 12.7 lb. of sulfur per 100 lb. of 13X molecular sieves at 90° F. and 210 psig. pressure, or about three times the loading measured with the natural gasoline. These differences in loading values of H_2S and sulfur constituents of natural gasoline were confirmed in a dynamic operation in which adsorption to breakthrough of mercaptans using Gasoline A was only 3 hours in length, while design data based on H_2S data called for 8-hour operation.

Adsorption of Components

Due to the multicomponent composition of the gasoline, there is much competition for the adsorptive sites of the molecular sieves. Each specified fraction of the gasoline will not be freed to the same extent of its individual sulfur types, due to differences in concentration and adsorption constants of the sulfur compounds as well as the hydrocarbons. Furthermore, since the sulfur specifications for the fractions are based on different sulfur types and levels, the adsorption-cycle length must be based on the fraction which first reaches its maximum specification.

It is also apparent that since the sulfur specifications are low, the design and operation of the adsorption must give a frontal-type breakthrough for the sulfur compounds. This will assure highest purity, as well as the greatest length of operation during the adsorption cycle, and a minimum of adsorbed nonsulfur-containing gasoline which may be lost on regeneration of the sieves.

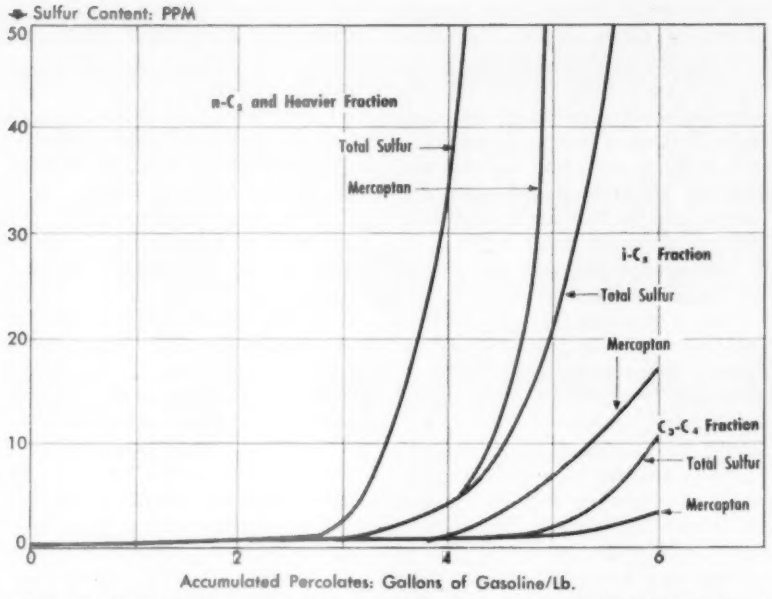
An illustration of this type of breakthrough is shown in Fig. 2. The two most general methods found applicable to design and operation to desulfurization by means of adsorption are the methods developed by Rosen[3] and Linde Co.[4] These methods have been highly successful in predicting experimental results.

Sulfur content. Table 3 and Fig. 3 show sulfur contents of fractions of the instantaneous percolates on charging the high-sulfur-content gasoline to a 2.1-in. i.d. by 3.4-ft.-long column at 100° F., 350 psig. pressure, and a liquid weight hourly space velocity (LWHSV) of 1.68. The instantaneous percolate is the gasoline which is flowing from the column at the time in question.

The total sulfur content of the propane-butane fraction of the instantaneous percolate reached the maximum specification level of 3.0 p.p.m. at a throughput of 4 gal. of natural gasoline per pound of molecular sieves. The i-pentane and n-pentane and heavier fractions reached the maximum mercaptan specification level of 3.0 p.p.m. at throughputs of 3.7 and 3.2 gal. per lb., respectively. Thus, the n-pentane and heavier fraction of the gas-

TABLE 2—COMPOSITION OF NATURAL GASOLINES

Component—	% by Weight of Gasoline	Sulfur Content: p.p.m. Total	Sulfur Content: p.p.m. Mercaptan
Gasoline A		885	746
C_3–C_4	53.7	450	450
iC_5	23.2	1,062	918
nC_5 and heavier	23.0	1,717	1,219
Gasoline B		2,265	970
C_3–C_4	55.1	1,500	768
iC_5	23.3	1,800	1,500
nC_5 and heavier	21.6	4,700	900



SULFUR CONTENTS of accumulated percolates when charging high-sulfur-content gasoline B to small adsorption column. Fig. 4.

oline first reaches the maximum specified sulfur content; and the length of adsorption must be designed around this fraction.

If the adsorption is stopped at the point at which the n-pentane and heavier fraction reaches maximum mercaptan specification on an instantaneous basis, the accumulated percolates are of very high purity as shown in Table 4. The accumulated percolates are the total amount of gasoline which flowed from the adsorption column from time zero to the time in question.

Stopping the adsorption at the point when the first fraction meets its maximum specification level on an instantaneous percolate basis may seem premature.

However, a further examination of Fig. 3 shows that breakthrough of sulfur compounds except in the case of mercaptans in the propane-butane fraction is very rapid beyond that point. For example, at a throughput of 4 gal. per lb., the instantaneous n-pentane and heavier fraction has a mercaptan sulfur content of 50 p.p.m.

Fig. 4, a plot of the sulfur contents of the accumulated percolates, also illustrates this point. The accumulated percolate of the n-pentane and heavier fraction reaches the maximum mercaptan level of 3.0 p.p.m. at a 3.8 gal. per lb. throughput. Thus, only a 18.8% increase is achieved if the adsorption is ended at this point; but the accumulated n-pentane and heavier fraction contains 3.0 p.p.m. mercaptan and 24 p.p.m. total sulfur, and the i-pentane fraction contains 3.0 p.p.m. total sulfur as compared with the better quality shown in Table 4. The decision on adsorption length is, of course, based on economics and the quality desired.

The sulfur content of the gasoline charged to the adsorber affects both equilibrium loading and the throughput at which the percolates exceed any specified sulfur level. An illustration is shown in Table 5, for Gasolines A and B. Throughput to breakthrough was 5 gal. per lb. for the 885-p.p.m.-sulfur-containing gasoline as compared to 3.2 for the higher-sulfur-containing (2,265 p.p.m.) gasoline.

TABLE 4—ACCUMULATED PERCOLATES TO 3.3 GAL. PER LB.

Fraction	Sulfur content, p.p.m. Total	Mercaptan
C_3–C_4	<1	<1
iC_5	1.8	<1
nC_5 and heavier	10.0	<1

Low temperature good. Economics dictate that the deethanizer bottoms be cooled as little as possible prior ot charging to the adsorption column. However, loading, purity, and throughput are favored by lower-temperature adsorption. Table 6 shows adsorption of Gasoline A at temperatures of 100° and 180° F. Throughput based on the mercaptan content of the n-pentane and heavier fraction was increased about 7% by lowering the temperature to 100° F., but the greatest advantage is seen in the lower temperature is seen in the propane-butane fraction.

The total sulfur content of this fraction was 1 p.p.m. from the 100° F. adsorption but was 14 p.p.m. when the adsorption was done at 180° F. In fact, at 180° F. the sulfur content of this fraction

TABLE 5—EFFECT OF SULFUR CONTENT OF GASOLINE

Adsorption: 100° F., 350 psig., LWHSV—1.68
Column: 2.1 in. i.d. by 3.4 ft. long

Total sulfur content of natural gasoline: p.p.m.	885	2,265
Throughput at breakthrough Gal./lb.	5	3.2

Sulfur content of instantaneous throughput at breakthrough	Total S p.p.m.	Mercaptan S p.p.m.	Total S p.p.m.	Mercaptan S p.p.m.
C_3–C_4	1-2		1	
iC_5		<2		1
C_5 and heavier		3		3

TABLE 3—TYPICAL EFFLUENT SULFUR DATA

(Adsorption: 100° F., 350 psig., liquid weight hourly space velocity (LWHSV)—1.68. Column: 2.1 in. i.d. by 3.4 ft. long—⅛-in. pellets 13X molecular sieves)

Fraction—	Instantaneous throughput, gallons of gasoline per lb. of sieves	Sulfur content: C_3–C_4 Total	C_3–C_4 Mercaptan	iC_5 Total	iC_5 Mercaptan	nC_5 Plus Total	nC_5 Plus Mercaptan
Feed B		1,500	768	1,800	1,500	4,700	900
Effluent	1.0	<1	<1	1.0	<1	1.2	<1
Effluent	2.0	<1	<1	1.3	<1	1.5	<1
Effluent	2.5	<1	<1	1.5	<1	2.0	<1
Effluent	3.0	<1	<1	3.5	<1	10.0	<1
Effluent	3.5	1.0	1.0	7.0	1.0	120	10.0
Effluent	4.0	3.0	3.0	20	5.8	350	43
Effluent	6.0	3.0	5.0	400	65	1,800	190

in the 180° F. adsorption was 14 p.p.m. from the beginning of the adsorption to the 1.5 throughput.

Efficiency was also affected by the rate at which the gasoline was charged to the adsorption column. In operations using a column of fixed dimensions increasing space velocity (vol./vol./hr.) from 0.5 to 1.0 decreased throughput to breakthrough by 19%. At a 2.0 space velocity, throughput was only 56% of that achieved at a 0.5 space velocity.

The length of the flow path through the bed of molecular sieves was also an effective factor. Operation at a fixed-feed rate, temperature, pressure, and column diameter but at varied bed depths showed that an increase in bed height of 71% resulted in a threefold increase in throughput to breakthrough. This increase was greatly in excess of what would be expected by using 71% more molecular sieves at the same operating efficiency or from the expected 25% increase in throughput by decrease of space velocity from 2.7 to 1.6 vol./vol./hr.

Commercial Adsorber

A commercial unit has been designed to sweeten 300,000 gal. per day of deethanized natural gasoline containing from 900 to 2,300 p.p.m. of sulfur. Table 7 summarizes the design and operating data. Two fixed beds are employed and effluents have specifications as shown in Table 1. Adsorption times are from 10.5 to 15 hours depending on the sulfur content of the charged natural gasoline and are designed on an instantaneous percolate breakthrough to assure product quality. At the end of the adsorption cycle the total loading on the molecular sieves is 10.65 lb. per 100 lb.

Of this, the loading of nonsulfur-containing constituents is 6.3 lb. per 100 lb. and equivalent to only 0.3% of the natural gasoline charged to the adsorber. Water loading is 0.35 lb. per 100 lb., showing a dehydration of the products. If desired in the regeneration, the sulfur-containing compounds, 4.0 lb. per 100 lb. of molecular sieves, can be recovered, and these have sulfur contents of 43%.

The economics of the process are, of course, dependent on the prices of the 13X molecular sieves (P in dollars) and the sieve life (L in years). Investment amounts to $75,000 + 73,000P, and annual operating cost is $64,000 + 73,000P/L. This process is economically equivalent to a caustic solutizer process when P/L is equal to $0.54 per lb. per year. At a cost of $1.50 per pound of molecular sieves, this process is equivalent to the caustic process if the molecular sieves have a life of 2.8 years.

Based on commercial processes in which sour propane and butane streams from natural gasolines are sweetened by adsorption on 13X molecular sieves, life spans of this length and longer are indeed promising. In these, cyclic operations of 6 months' duration have been carried out with little reduction in efficiency of the molecular sieves. An oxidative regeneration to burn off constituents not desorbed by the hot natural-gas regeneration has not been required.

Regeneration

Due to the importance of molecular-sieve life to economics, work is currently being done to complete tests of regeneration techniques in cycles of extended numbers to accurately determine life. Since adsorption steps of the cycles are from 10 to 15 hours long and two columns are employed in parallel, equal times can be used for careful regeneration. Several regeneration techniques are possible. One which includes recovery of the sulfur compounds comprises:

1. A downflow draining of the column under adsorption pressure and temperature at the same liquid withdrawal as during adsorption.
2. A short downflow purge with an inert or natural gas to remove most of the remaining unadsorbed natural gasoline.
3. An upflow purge of hot inert or natural gas. The gases flowing from the top of the column are directed to a condenser in which the sulfur compounds are recovered.
4. A continued upflow purge of the hot gases at 550°-700° F. with the condenser being bypassed.
5. A downflow cooling of the adsorbent using sweetened natural gasoline.

This method can be modified if it is not desired to condense the adsorbed sulfur components. The upflow purge of the regeneration gases is necessary to keep the bottom of the molecular-sieve column as active as possible to assure product quality during the succeeding cycles. However, the gas flow rate should be such as to minimize lifting of the bed while retaining efficient regeneration so that fracturing of the molecular sieve pellet will be minimized.

Deactivation of the sieve column is gradual, but a good recovery in capacity is regained by a periodic augmentation of the regeneration by a controlled burnoff of strongly adsorbed sulfur compounds and hydrocarbons. The oxygen content of the burnoff gas is controlled so that the bulk temperature of the molecular-sieve pellets does not exceed 1,050°-1,100° F.

TABLE 6—EFFECT OF TEMPERATURE

Adsorption: 350 psig., LWHSV—2.7
Column: 2.1 in. i.d. times 2.0 ft. long
Natural Gasoline A—885 p.p.m. sulfur

Adsorption temperature: °F.	100	180
Breakthrough: gal./lb.	1.6	1.5
Specified sulfur content of instantaneous percolate at breakthrough		
C_3—C_4 (total sulfur)	1	14
iC_5 (mercaptan)	3	3
nC_5 and heavier (mercaptan	3	3

TABLE 7—COMMERCIAL NATURAL-GASOLINE SWEETENER

Adsorber design:
Two beds: 5 by 50 ft.
Molecular sieves: 73,000 lb. total
Type of molecular sieves: 13X
Size of molecular sieves: ⅛-in.

Operating conditions:
Adsorption:
Pressure, psig. 350
Temperature, °F. 100
Time, hours 15 with 1,000-p.p.m. gasoline
10.5 with 2,200-p.p.m. gasoline
Feed Rate, g.p.m. 208

Acknowledgment

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4. Design Manual for Octane Improvement, Book I, Linde Co.

Is it practical?
Does it fit the particular application proposed?
Is it economical?

This is what Sun Oil wanted to know about

Gas turbines in gas-processing applications

And 20 months' operation provide all yes answers

BY B. L. SHORT
Sun Oil Co.
Dallas

GAS TURBINES and the turbine-heater installation of Sun Oil Co. in its Laverne gas-products plant have proved to be very reliable during 20 months of operation. While there have been few problems connected with the shakedown period, the turbine section of the plant has given less trouble than some of the other parts of the plant using "standard" equipment.

The practical application of gas-fired turbines for industrial use began in the early 1930's. Gas-processing plants were operating many years before this, but it was only recently that the two were combined in a plant specially designed to take full advantage of the turbine's features.

The Laverne plant is located in Harper County, Oklahoma, and is operated by Sun for 62 owners.

Justifying New Equipment

To justify the installation of new equipment in a gas-processing plant, we must be able to answer positively these three questions: Is it practical? Does it fit the particular application proposed? Is it economical?

Unique Installation

The final determinant in selecting equipment is the economics of the installation. Thus, the installation of gas fired turbines in the Laverne plant was dependent upon certain anticipated economies:

1. Investment cost. A gas-fired turbine has a first cost comparable with the equivalent size reciprocating engine. Most commercial installations previously had been of the 5,000-kw. size or larger. The units installed in the Laverne gasoline plant are rated 1,150 hp. at 80° F. and sea level.

2. Maintenance. Maintenance requirements, both from a standpoint of required personnel and down time, were originally estimated to be less than required for a conventional reciprocating-engine installation.

3. Operating personnel. It was anticipated that the turbines would not require full-time attention of an operator. The design of the plant instrumentation and control system included the installation of kilowatt meters on the central operating control board.

4. Operating time. The turbines were expected to operate for periods of up to 18 months without major maintenance problems or overhaul.

5. Ease of operation. Starting and putting the units on line was considered an advantage. Any one of the units can be started and placed on the line in a maximum of 5 minutes. No waiting time for operating temperatures to come up to a certain level is required.

6. Design. A turbine is no different from any other piece of gasoline-plant equipment. It must fit the particular problem. In a gasoline plant the turbine must not only furnish a source of energy such as driving a generator or compressor, it must also be considered as a source of heat energy. This brings us to the final item to be considered in planning the installation.

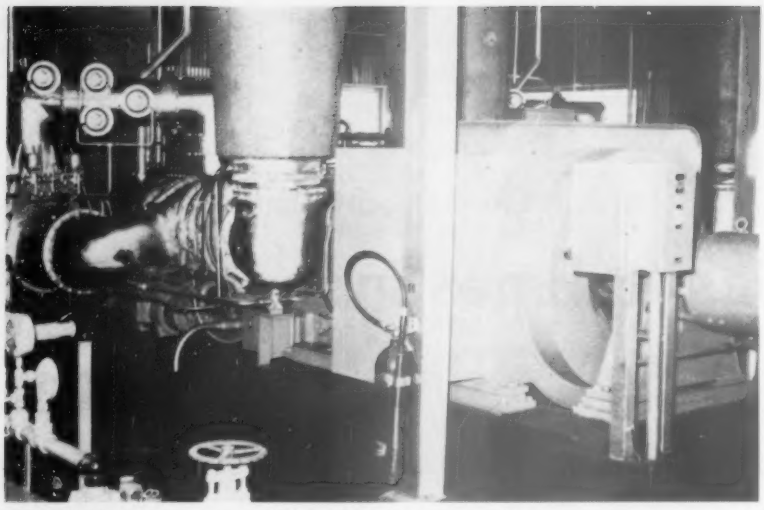
7. Fuel economy. It was anticipated that the turbines would fit into the over-all plant-design scheme by driving electric generators, with the turbine exhaust heat being fed to a process-type heater where additional fuel gas would be added and the mixture refired. An over-all fuel requirement of approximately 1.6% of the throughput was calculated.

Type of units. The gas turbines in the Laverne plant each drive 1,000-kw., 2,400-volt generators at 1,200 r.p.m. Fig. 1 is a view of the generator end of one of these units. One large advantage in using turbines lies in the fact that the only utility requirement is some means of cooling the oil. In this plant the oil is cooled by a small stream of water from the main plant circulating system. Fig. 2 shows this oil cooler in the lower left corner. To the right may be seen the d.c. batteries which are used for starting and also for control. This is a 24-volt d.c. system. Fig. 3 is a closeup of the combustion chamber on one of the turbines.

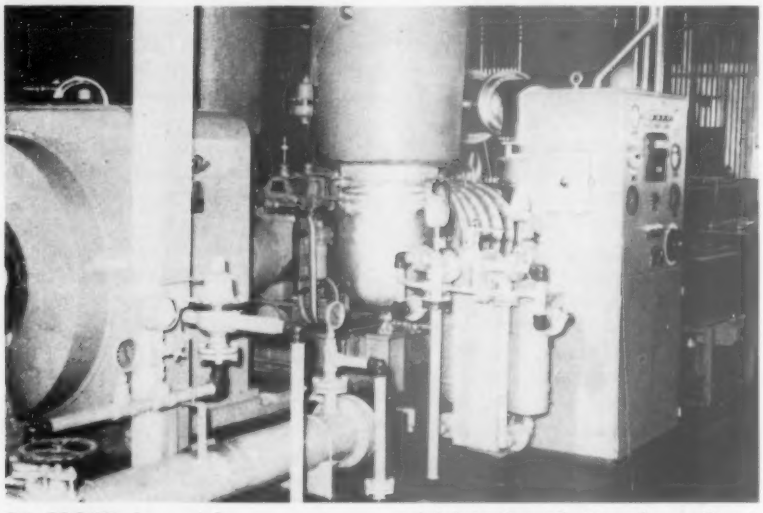
Installation

Certain features of the turbines were considered in the layout and design of the plant. These design considerations resulted in the installation of the turbines in a central generating facility. The turbine exhaust is fed to a process heater. Fig. 4 is a view of the heater and duct work connecting the turbines to the heater. The vertical stack shown on each duct is necessary for startup of each turbine. The Y-type ducting allows only the required

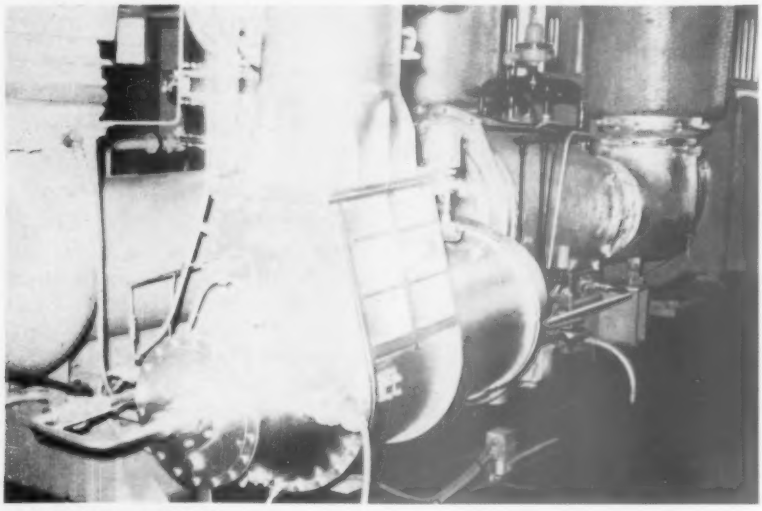
Paper presented at NGAA annual meeting, Dallas, 1961.



GENERATOR END of one of the 1,000-kw. gas turbine-generator units at the Laverne plant. Fig. 1.



OIL COOLER, lower left, uses water to cool lubricating oil. No other utility is required. Fig. 2.



COMBUSTION CHAMBER on one of the turbines. This is starting point for power generation. Fig. 3.

amount of heated turbine exhaust to flow to the lower section of the heater, where it is refired with additional fuel gas. The remainder of the turbine exhaust enters the convection section of the heater through the top duct and exchanges its heat with the incoming process streams.

Originally four individual services were incorporated in the process heater: still reboiler, regeneration gas, deisobutanizer reboiler, and hot circulating oil. Revision of the heater has allowed us to add a fifth coil which is used to preheat the depropanizer feed stream. The turbine exhaust is approximately 97% air and contains no products of incomplete combustion. In a sense, the turbine is used as a preheater for the process heater. Design over-all thermal efficiency for the plant, that is, the percentage of B.t.u.'s recoverable as usable energy from the total amount of B.t.u.'s burned in the plant, ranged from 76 to 81%, depending upon the gas throughput. Actual tests have shown this efficiency to be approximately 80%.

Another result of using the gas-fired turbines is that it allowed an all-electric plant in which drives other than the gas turbines are electric motors. There are two exceptions: One of the fire pumps and one of the standby water-well pumps are driven by natural-gas-fired engines. Fig. 5 shows the central control panel for the plant.

With all electric drives and more or less self-regulating generator facility, it was felt that the operator could maintain closer and firmer control over the plant by having all process conditions monitored and brought into a central control room. Here, on a semigraphic panel board, he can determine actual operating conditions within the plant and make most of the necessary adjustments from this location. This by no means indicates that he does not move from this control room. Somebody has to keep the automatic controls working. Seriously, the operators' grasp of the plant is much better, we feel, with this centralized panel board.

Actual Experience

The Laverne plant has been in operation not quite 20 months. During this period we have had only one serious problem with the gas turbines. A small metal piece inside

of the units came loose and passed through the turbine wheels causing some damage to the turbine. Mechanical down time (forced outage or down time for inspection or maintenance) since the plant began operating has been approximately 575 hours on all three turbines, 332 hours of which were caused by the accident.

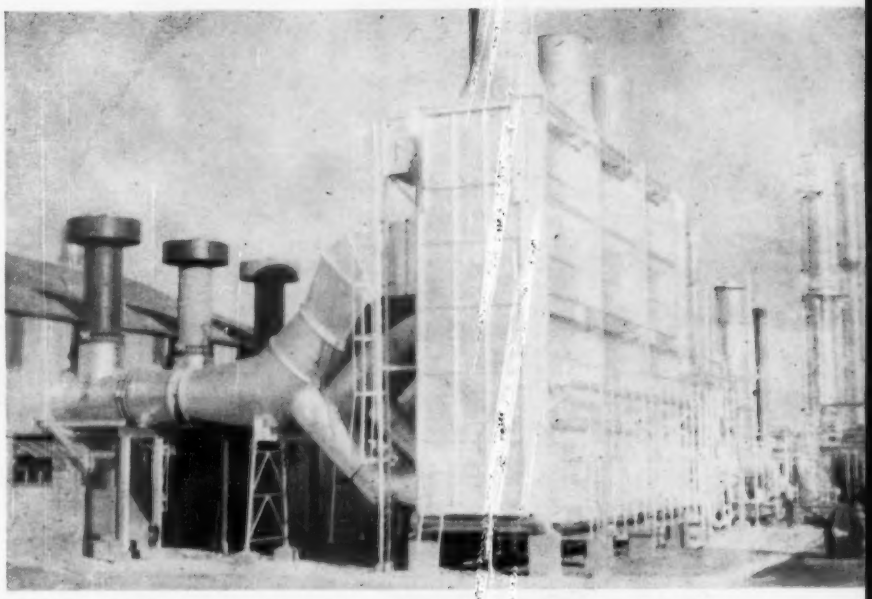
A good portion of the remaining 240 hours has been due to the fact that these were units new to the industry and we were keeping a closer check in order to assure better performance. We anticipate less mechanical down time. We are using approximately one-half to two-thirds of our usual size maintenance crew.

Over-all, the operation of the turbines has been very good. We have not attempted to set any records for continuous operating time on any of the machines. The longest period of time any one machine has operated without shutdown is 2 months. We have alternated turbines in order to maintain a close check on the units. Of the four shutdowns caused by the turbine control system itself, at least three were malfunctions of the control system.

No operator is assigned to the generators. The operators in the plant check the generator facility as they do the remainder of the plant.

Since this is an all-electric plant, the problem of stopping and starting large motors had to be dealt with. There are two 500-hp. motors driving the refrigeration compressor and recompressor. These motors are started across the line. The response of the turbine governors when these large motors are started or stopped has been exceptional. In the initial tests, when the plant was originally started up, we actually threw the motors on the line without any other preparation other than advising the operator of our intentions. The result was that the turbines picked up the load with only a momentary drop in frequency of about 2 c.p.s. In the same manner, we dropped both motors off the line and the turbines responded similarly.

Fuel requirements have been better than the design feature. Actual fuel required is less than 1.2% of the total gas throughput to the Keyes plant.



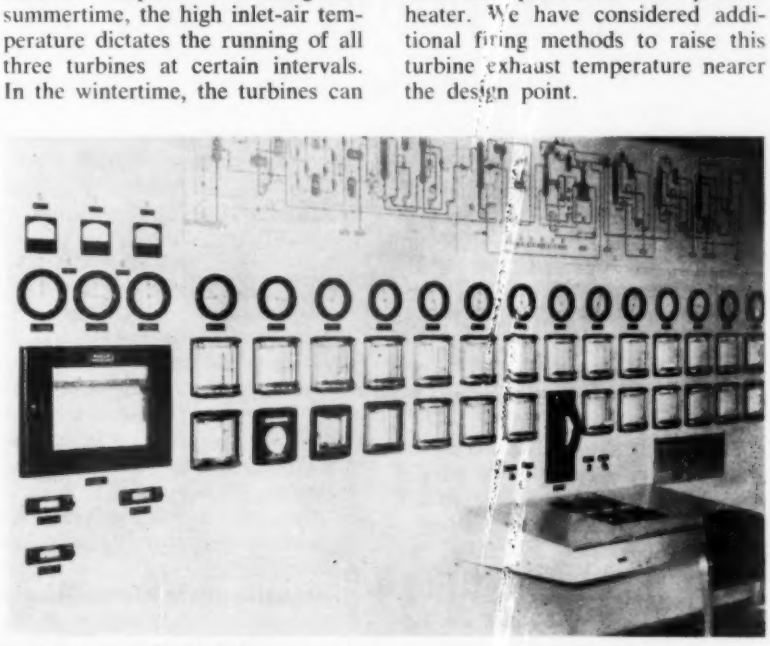
PROCESS HEATER takes turbine exhaust, part of which is refired with additional fuel gas. Remainder of exhaust enters convection section directly. Fig. 4.

Future Considerations

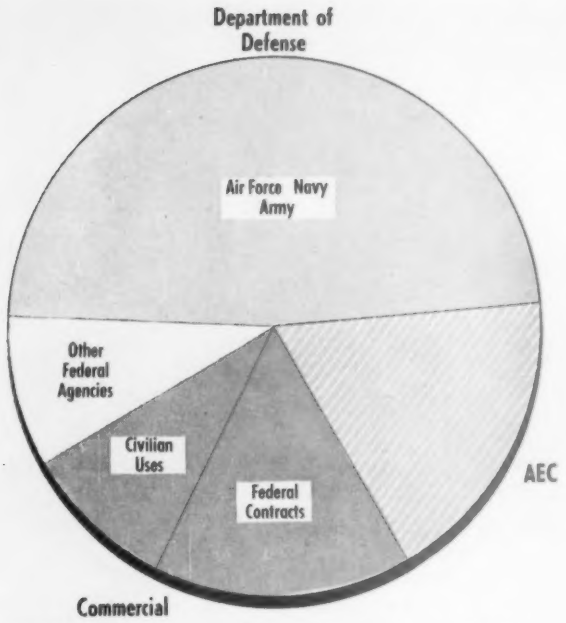
The first winter of operation taught us that the inlet air filters should have shrouds to deflect snow or sleet from the moving filter screen. Sleet and snow accumulation caused the screen to freeze solid on one occasion.

The turbines are very sensitive to atmospheric conditions, especially ambient temperature. During the summertime, the high inlet-air temperature dictates the running of all three turbines at certain intervals. In the wintertime, the turbines can carry the load with some to spare.

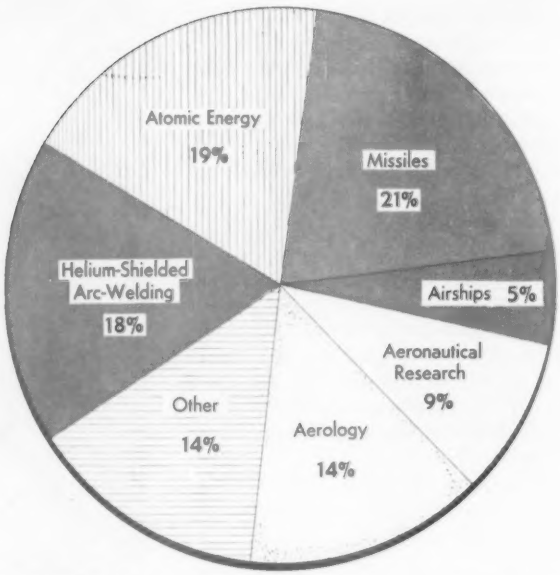
The biggest problem that the lower ambient temperatures present is the low turbine exhaust temperature that results. This low exhaust temperature, in turn, causes lower temperatures throughout the heater that must be made up by additional firing. The required amount of air used in the turbine has occasionally presented a problem in balancing the heat requirements in the process heater. We have considered additional firing methods to raise this turbine exhaust temperature nearer the design point.



CENTRAL CONTROL PANEL for the Laverne plant. Plant design allows for most of the necessary adjustments in operation to be made from the control room. Fig. 5.



HELIUM USE by principal customers in the United States. Fig. 1.



DISTRIBUTION of helium for various uses, military and civilian. Fig. 2.

WHERE WE STAND ON HELIUM TODAY—1

Are we assured of an adequate and continuing supply of helium?

Maybe, if a proposed conservation program is adopted

BY PAUL V. MULLINS
General Manager, Helium Operations, Bureau of Mines, U. S. Department of the Interior, Amarillo, Tex.

HELIUM CONSUMPTION has increased nearly tenfold in the past 12 years. This spurt in demand prompted a critical review of the nation's helium reserves. This study pointed up the fact that the principal resources of this gas are contained in natural-gas reserves that are being dissipated at a fairly rapid rate by use of the natural gas as fuel.

A broad helium-conservation program involving recovery of helium from natural gas for storage underground and later used as needed is being proposed to guarantee the nation an adequate supply of helium for the future.

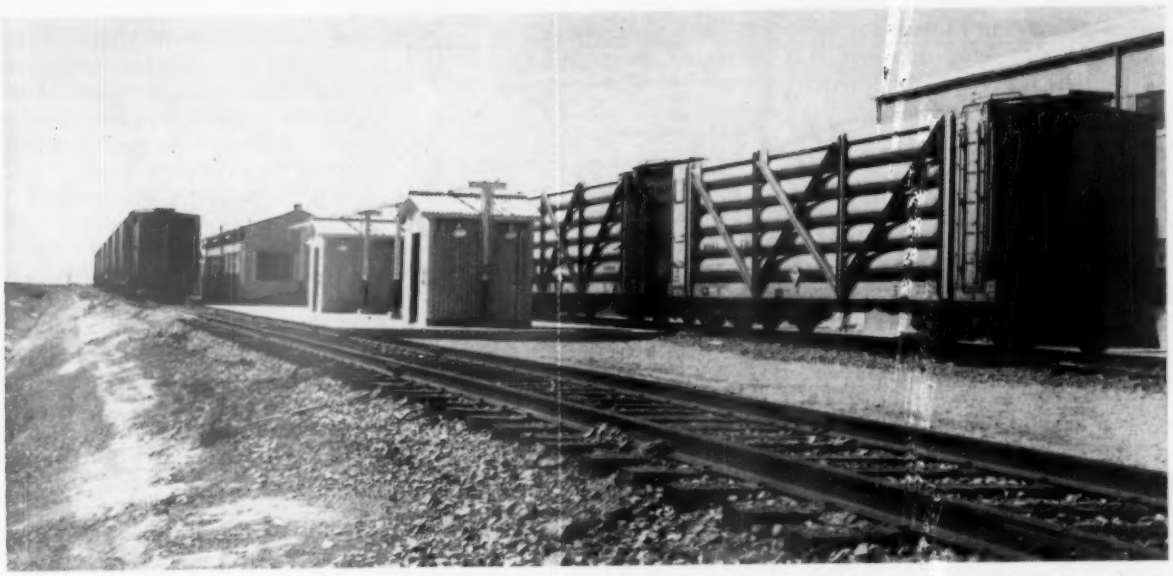
Helium is best known as a lightweight, nonflammable gas used for inflating dirigibles, blimps, and balloons; however, present uses include important roles in shielded-arc welding, nuclear-energy development, missile fabrication and operation, space exploration, and a number of other applications in several fields of technological investigation and development.

Helium is produced by extraction from helium-bearing natural gases. The Bureau of Mines, U. S. Department of the Interior, operates five helium-production plants at Amarillo and Exell, Tex.; Otis, Kans.; Shiprock, N. M.; and Keyes, Okla. The newest plant, at Keyes, began production in August 1959. (See Part 2 of this article, p. 101.) This plant increased annual helium output by about 80%. Output is now adequate to meet present demands and those predicted for the next 2 to 3 years.

The rapid and sustained increase in helium consumption prompted a critical review of the nation's helium resources.

Helium consumers. Over 75% of the helium produced is consumed by federal agencies, principally defense agencies and the Atomic Energy Commission. Fig. 1 shows the approximate proportions of helium used by the Defense Department,

Paper presented at annual NGAA meeting, Dallas, 1961. Previously presented at annual CNGA meeting, Los Angeles.



REFRIGERATED TANK CARS are used to ship helium from the producing plants. Shown here is the helium-loading station at the Keyes, Okla., plant. Fig. 3.

Atomic Energy Commission, and other principal classes of consumers. A small amount—less than 1%—is exported.

The general pattern of helium distribution has remained fairly constant for a number of years. The increase in use has been fairly uniformly distributed between federal and nonfederal consumers.

Helium Uses

The usefulness of helium derives from its unique physical properties. It is inert. It is lighter in weight than any other gas, except hydrogen. It diffuses more rapidly, flows through a hole faster, conducts heat better, and transmits sound at a higher velocity than any other gas, except hydrogen. It conducts electricity better than any gas, except neon. Compared to other gases, helium has a lower solubility in water and other liquids, lower refractive index, and lower temperature of liquefaction. These unique properties are useful for many industrial and scientific applications.

Helium is used almost exclusively as the lifting gas for airships and for observation, advertising, meteorological, and toy balloons. At normal atmospheric pressure and 60° F., 1 M.c.f. of helium weighs only 10.54 lb. and provides a lift in air of more than 65 lb.—92.64% as much as hydrogen.

Welding. Helium is used as an inert gaseous shield around the arc and molten metal during some arc-welding operations on aluminum, copper, titanium, magnesium, stainless steel, and other metals. An inert helium atmosphere is used in the production and fabrication of titanium and zirconium.

Transistor crystals of silicon and germanium are grown in helium to protect these semiconductor crystals from exposure to air during their growth.

Helium is used in chromatographic gas-analysis equipment as the carrier or sweep gas. It aids materially in modern techniques for rapid and accurate analyses.

Helium is used with oxygen in breathing atmospheres for persons suffering from asthma and other respiratory diseases. The helium-oxygen mixture is much lighter than air and will flow through restricted respiratory passages more readily. Consequently, more oxygen can be breathed with the same muscular effort. Helium is mixed with some anesthetics to reduce explosion hazards in hospital operating rooms.

Helium - oxygen breathing mixtures are used also by divers in deep-sea rescue and salvage operations. The low solubility of helium in the blood stream—as compared to nitrogen from the air—minimizes dizziness and loss of mental agility when breathing these mixtures under pressure.

Reservoir sleuth. In some instances, helium has been used as a tracer element added to natural gas that is injected into underground reservoirs to determine the underground movement of the injected gas in cycling and pressure maintenance in oil and gas fields.

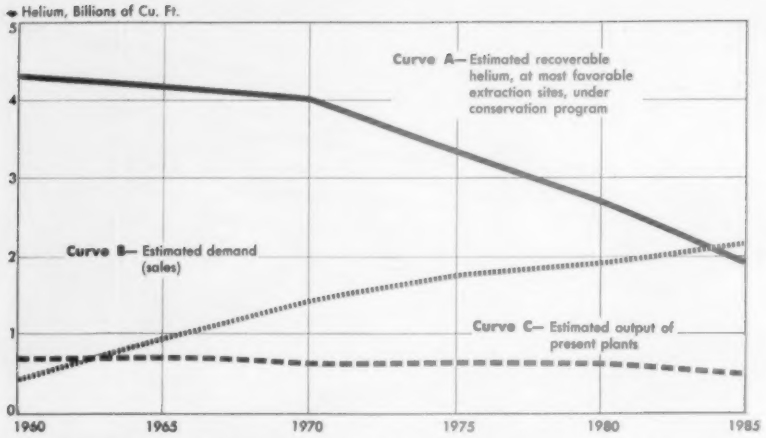
Helium is used to detect minute leaks in pressure and vacuum systems, such as vessels for nuclear energy investigations and sealed refrigeration units.

Because of its low refractive index, it is used to fill the space between lenses in range finders and other optical instruments.

It is useful as a heat-transfer medium in gas-cooled nuclear reactors because of its heat capacity and resistance to radioactivity.

Helium is used in a variety of ways in ballistic missile fabrication and operation. It is used in shielded-arc welding of special metals and alloys used in fabrication. It is stored under pressure in the missiles to pressurize fuel components and to accomplish other operational features.

The extreme cold obtainable with liquid and solid helium—near absolute zero temperatures—has opened a broad field of research on properties of material and physical laws at extremely low temperatures. Research on "free radicals" is an important phase of scientific investigation that is facilitated by liquid helium. Free radicals are molecular fragments normally having a life of a few thousandths of a second during chemical reactions, but "freez-



FORECAST OF PRODUCTION, demand, and conservation under proposed program, for helium in the period 1960-1985. Fig. 4.

ing" them in liquid helium can extend their life indefinitely.

The frozen free radicals can then be studied with comparative ease. It may be possible to control the release of their energy and provide a useful source of power. The high energy levels and low mass involved may make this power especially useful in space flight.

Electrical. At the temperature of liquid helium, some metals become superconductors; they exhibit little or no resistance to the flow of electricity. This phenomenon has led to the development of instruments called cryotrons, which are operated in baths of liquid helium to perform the function of transistors or vacuum tubes and permit construction of extremely small, highly reliable computers.

MASER (microwave amplification by stimulated emission of radiation) and other low-noise amplifiers operating in baths of liquid helium give about 1,000 times the amplification obtainable from conventional systems of equivalent size and power requirements. The increased amplification is important in ultra-high-frequency communications, radar, and radio astronomy.

Fig. 2 shows the approximate distribution of helium among various consumers. A survey was made in 1955 of the commercial (nonfederal) uses of helium. Table 1 gives the results, which indicate, among other things, that a little over 50% of the helium sold to commercial consumers was used on federal Government contracts, so that nearly 90% of the helium produced was used directly or indirectly for the benefit of the federal Government.

Production Process

Helium is a minor constituent—usually less than 2%—of some natural gases. It is extracted by liquefying virtually all of the other constituents in the gas and then separating the helium-rich gas phase from the liquid phase. All Bureau of Mines helium plants use the same basic low-temperature process involving first, the extraction of "crude helium" and second, its purification. (See Part 2 of this article, Page 101, for details.)

Helium Shipment

Most of the helium produced—over 80%—is shipped in railway tank cars of special design and construction shown in Fig. 3. The tank cars are made up of 30 steel tubes, 18 in. o.d. by 33 ft. long with a wall thickness of 0.75 in., mounted in a framework.

The tank cars are built under ICC Regulations No. 107A****. The tubes are made from steel having a tensile strength of approximately 105,000 psi. Each car has a specified filling pressure based on the minimum tensile properties of samples of steel taken from each tube when the cylinder is made.

A car weighs about 235,000 lb. and costs approximately $110,000. The bureau now has 157 helium tank cars in service. Filling pressures range between 2,100 and 3,675 psig. with corresponding helium volumes ranging from 200,000 to 308,000 cu. ft. measured at 14.7 psia and 70° F.

Tank cars having filling pressures below 2,750 psig. are filled directly from the purification units. Cars having filling pressures above 2,750 psig. are first filled to this pressure directly from the purification units and then are topped off by the use of a diaphragm-type compressor. The remainder of the helium produced is shipped in automotive trailers and small cylinders.

Current prices. The present retail price of helium in tank-car lots is $15.50 and $19.00 per M.c.f. to federal and nonfederal consumers, respectively. The average cost of helium transportation in tank cars from plants in Texas and Oklahoma to the East and West coasts is in the general range of $6 to $9 per M.c.f., depending on capacities of cars, particular destinations, and other factors.

The Navy Department and the National Bureau of Standards Cyrogenic Engineering Laboratory have been quite active in investigating shipment of helium as a liquid.[1 2] The Navy Department and the Air Force are now engaged in a joint operation to test a moderate-size helium liquefier, automotive transport for liquid helium, and liquid-helium-handling equipment. Pros-

TABLE 1—HELIUM USES BY COMMERCIAL (NONFEDERAL) CONSUMERS

Uses—	Per cent of total commercial use	Division of use— Per cent for federal contracts	Per cent for other purposes
Welding	64.5	52.3	47.7
Leak detection	8.5	31.7	68.3
Titanium production and fabrication	7.5	83.9	16.1
Research	5.1	63.2	36.8
Controlled atmosphere	5.0	22.5	77.5
Medical	2.6	0.0	100.0
Transistors	2.3	67.1	32.9
Zirconium production	1.6	100.0	0.0
Aircraft components	1.5	99.0	1.0
Advertising and toy balloons	0.6	0.0	100.0
Lighter-than-air crafts	0.6	0.0	100.0
Miscellaneous	0.2	27.1	72.9
Total	100.0	51.8	48.2

pects appear favorable for practical large-scale shipment of liquid helium with greater economy and convenience than afforded by present shipment as a compressed gas.

Technical and cost data. The Bureau of Mines has compiled recent reports on phase-equilibrium data for three helium-bearing natural gases at temperatures and pressures of interest in helium extraction. Also, a report has been prepared on investment and operating costs for the two largest plants—Excell and Keyes. These reports are on "open file" and available for inspection at the Bureau of Mines, Helium Activity offices in Amarillo, Tex., and Washington, D. C.

Resources and Conservation

For nearly 40 years, the Bureau of Mines has conducted a survey to obtain and analyze samples of natural gas from wells drilled in the United States in exploration for oil and gas. Where important, information is obtained also on the geology, reservoir characteristics, and estimated gas reserves. The purpose is to detect the occurrence of helium and evaluate the nation's helium resources. The results of gas analyses made in this survey have been published by the Bureau of Mines.[3,4]

Table 2 gives a summary of principal known helium resources in the United States by geographical location and separated into primary and secondary resources depending on the quantities available and economical recovery factors. It will be noted from this summary that all the primary resources are contained in natural-gas reserves in the Texas Panhandle, Oklahoma Panhandle, and western Kansas.

This gas is being transported to fuel markets at rates which will deplete the fields in about 25 years, at least from the standpoint of practical large-scale helium extraction and recovery. Existing helium plants in the area have the capacity to extract only about 15% of the helium from the gas being transported.

Big annual loss. The recoverable helium in the primary resources is about 130 billion cubic feet. While this reserve of helium-bearing gas is relatively large, the fact remains that at the present rate of use, about 4 billion cubic feet of helium is lost annually as the natural gas is consumed as fuel. Depletion of the helium resources is predictable and foreseeable. Thus, the nation is confronted on one hand by rapidly increasing use and importance of helium—for essential defense activities and valuable technological developments—and on the other hand by relatively rapid depletion of its primary helium resources.

A logical course of action is to stop loss and waste of a major part of this helium by extracting and recovering helium from natural gas en route to market. To this end, the Department of the Interior in 1958 developed a long-term and large-scale conservation program. Legislation to accommodate the program was passed recently by the Congress and approved by the President. The bill becomes effective March 1, 1961.

The program involves construction of a number of helium-extraction plants on natural-gas-transmission lines to extract helium from natural gas en route to fuel markets. The Department would endeavor to interest private industry in financing, constructing, and operating the plants. The product stream from the plants would be in the form of crude (unpurified) helium. It would be purchased under long-term contracts by the department for transportation to, and underground storage in, the government-controlled Cliffside gas field near Amarillo.

Future production and use. The predicted production and disposition of helium in the period 1960-1985 is illustrated in Fig. 4. Curve A is the estimated annual availability of recoverable helium in natural gas that will be transported to fuel markets during the specified period from the most practical recovery sites on pipelines originating in the aforementioned three-state area. Curve B is the predicted annual consumption during the period. Curve C represents the predicted annual output of the five existing production plants, which will have to be augmented soon by purifying a part of the crude helium from conservation plants and, thus, will meet market demands represented by curve B.

The area between curves A and C represents a volume of helium amounting to about 77 billion cubic feet that could be recovered at helium-conservation plants. The area between curves A and B, representing about 52 billion cubic feet of helium, is that which it is estimated could be stored underground for future use beyond 1985. The indicated volumes that may be extracted and stored will be decreased appreciably by each year of delay in placing the program in effect.

The Department of the Interior believes that the users of helium should pay for the conservation program. The program would be financed by increasing the retail price of helium to defray all costs, including depreciation and interest, over a period of about 25 years. It is estimated that the present prices would need to be increased about $25 pe

TABLE 2—PRINCIPAL HELIUM RESOURCES OF THE UNITED STATES*
(Billions of cubic feet at 14.65 p.s.i.a. and 60° F.)

Geographical location	Primary resources†	Secondary resources‡	Total
Arizona	....	0.6	0.6
Colorado	....	0.6	0.6
New Mexico	....	0.2	0.2
Texas-Oklahoma-Kansas§	161.7	28.4	190.1
Utah	....	5.8	5.8
Total resources	161.7	35.6	197.3
Total recoverable helium¶	130.0	‖29.0	159.0

*Estimate July 1960 of helium resources in place in natural-gas reservoirs—helium content 0.3% or more.

†Primary resources defined as those sufficient to provide 100 M.M.c.f. of recoverable helium per year for a 20-year period at individual plant sites.

‡Secondary resources defined as those not sufficient to provide 100 M.M.c.f. of recoverable helium per year for a 20-year period at individual plant sites.

§Includes Texas Panhandle, Hugoton, Keyes, Greenwood, Cliffside, and some smaller gas fields in the Texas Panhandle, Oklahoma Panhandle, and western Kansas.

¶Estimate of recoverable helium from helium resources; takes account of unavoidable losses in processing, optimum economical plant capacity, seasonal fluctuations in helium-bearing gas supplies, field abandonment upon depletion, and other factors.

‖Recoverable helium from secondary resources could vary widely, depending on economic choice of plant size and life, quantity of resources, helium content, conditions of gas availability, gas composition, and other factors.

M.c.f. If the present market distribution prevails, federal agencies, which consume directly or indirectly over 90% of the helium, would pay the major share of the cost of the helium-conservation program.

Alternatives. Alternatives to the conservation program have been considered. It seems unreasonable to limit the use of helium when relatively large sources of helium are available. These can and should be used to obtain helium.

It is impractical to contemplate holding the helium-bearing natural gas in the present reservoirs for future use because virtually all of the gas is destined for domestic fuel markets and constitutes the only reasonable, economical, and practical source of domestic fuel.

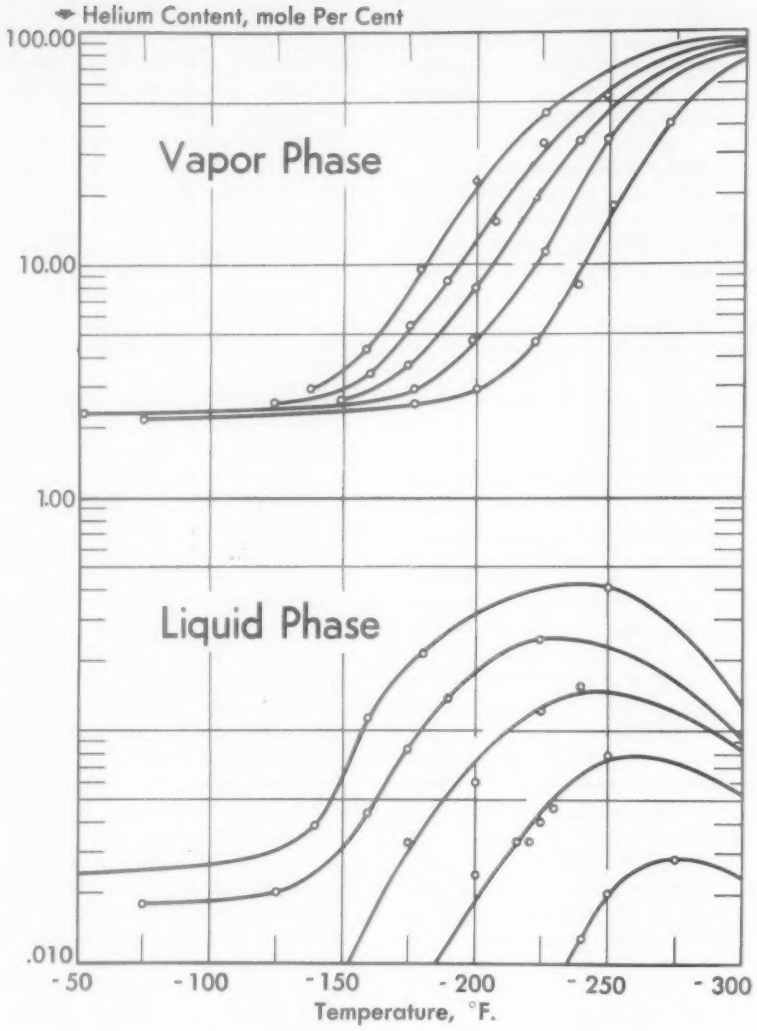
Dependence on the known helium resources might be satisfactory during the next 10 to 15 years, depending upon the growth in demand. If depletion of the presently known resources of helium is allowed to continue, the nation could be limited in the future to recovery of small amounts at great expense from depleted and marginal sources.

Prospects are not bright for new discoveries of major helium sources in the United States to augment the supply. In spite of extensive exploration for oil and gas, additional major quantities of helium have not been discovered in the past 10 years or more. During the past 30 years, the number of known helium sources has been nearly static for the past 20 years, and, during the past 10 years, has declined steadily because of the consumption of helium-bearing gases as fuel.

There is no reason at the present time for depending on helium sources outside the United States. There are few occurrences of helium in foreign countries and no development of large-scale reserves of helium. The obvious disadvantages are the probable high cost and the uncertainty of availability under circumstances that might arise in the future.

It is impossible to predict what new uses may be found for helium in the future, but it is reasonable to predict from present uses and from the general trend of new uses that a helium shortage could handicap the nation seriously in the maintenance of national defense and in the pursuit of technological developments and improvements.

This risk can be eliminated for many years in the future by initiating the helium conservation program now. Officials of Government and industry and prominent scientists have concurred with this conclusion. They have endorsed the helium - conservation program and urge immediate action now to conserve this unique and useful natural resource.



EQUILIBRIUM HELIUM CONTENT of vapor and liquid phases for gas feeding Keyes, Okla., plant. The chart is based on experimental values obtained by the Helium Activity Research Laboratory, at various temperatures and pressures. Similar charts can be worked up for other plants.

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2. Mann, D. B., Birmingham, B. W., and Vander Arend, P. C., "Technical Aspects of Large-Scale Liquid Helium Liquefaction and Transportation": Proceedings of the 1957 Cryogenic Engineering Conference, National Bureau of Standards, Aug. 19-21, 1957, pp. 125-131.

3. Anderson, C. C., and Hinson, H. H., "Helium-Bearing Gases of the United States": Bureau of Mines Bulletin 486, 1951, 141 pp.

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WHERE WE STAND ON HELIUM TODAY—2

Keyes plant makes helium at average cost of $9.11 per M.c.f.

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and
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THE $11,000,000 Keyes helium plant, Fig. 1, was constructed under an expedited schedule to supply the urgent and growing demand for helium. Shortages reached critical proportions in the months preceding the completion of the plant in August 1959. Construction was started in December 1958.

The plant, located near Keyes, Okla., processes 2% helium-bearing natural gas from Keyes gas field. During fiscal year 1960 the plant produced and shipped 263 M.M.c.f. of helium, equivalent to an annual rate of 290 M.M.c.f. Production cost was $9.11 per M.c.f.

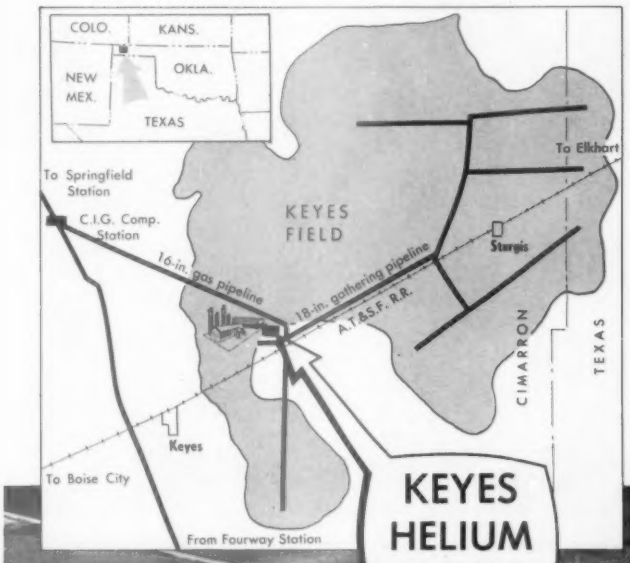
A low-temperature process involving two steps is used to produce the helium. The first separates a crude-helium product from natural gas, and the second purifies crude helium to a high-purity product.

The high-purity, Grade A helium is shipped to customers in specially constructed railway tank cars at 2,100 to 3,675 psig.

Building schedule. Construction of the new plant was undertaken with a time schedule that even the most optimistic questioned at times. Ground was broken early in December 1958 and the plant was completed and put on stream August 2, 1959. The first tank car of helium was shipped August 17, 1959, less than 9 months after breaking ground. Less than 11 months elapsed from the time of authorization to the time of shipping the first car of helium.

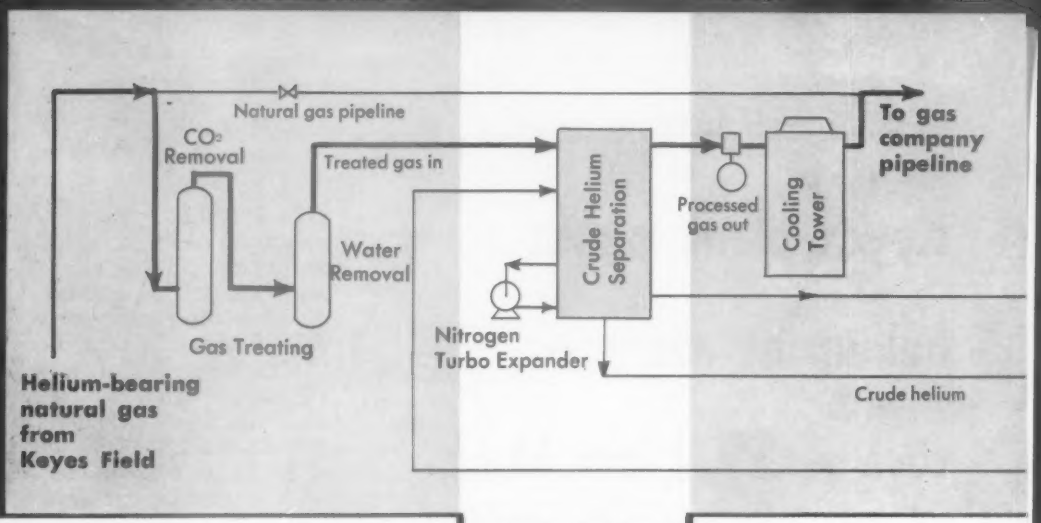
Source gas. Helium-bearing natural gas is supplied to the plant from nearby Keyes gas field under a gas-processing agreement between the United States and Colorado Interstate Gas Co. This agreement gives right to extract helium from the natural gas as it leaves the

From U. S. Bureau of Mines information circular.



PLANT LAYOUT for Keyes plant is shown in photograph below. Fig. 1. Location of the plant and gas field, and schematic of gathering and delivery systems are shown at left. Fig. 2.

Keyes Helium Plant Diagram



field on the way to fuel markets. The physical arrangements for supplying gas are shown in the map, Fig. 2.

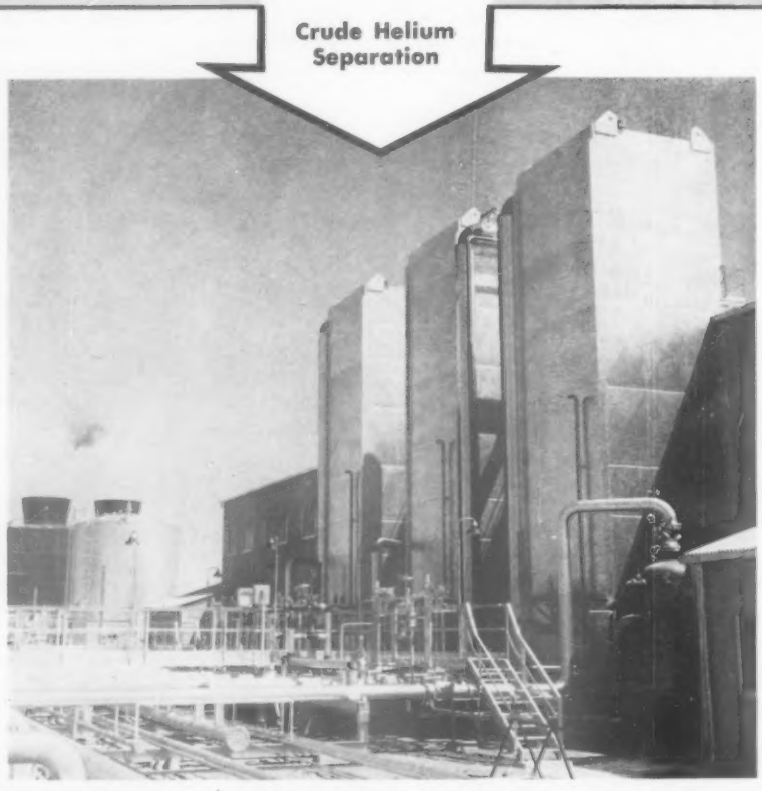
The agreement is for 20 years and for such period thereafter that the volume and composition are suitable for processing. The agreement also provides for close cooperation between the Bureau of Mines and Colorado Interstate Gas Co., and recognizes that helium extraction must be accomplished in a manner that meets the company's gas-marketing requirements. During the past fiscal year the daily gas rate has varied from about 30 to 61 M.M.c.f.d.

The Plant

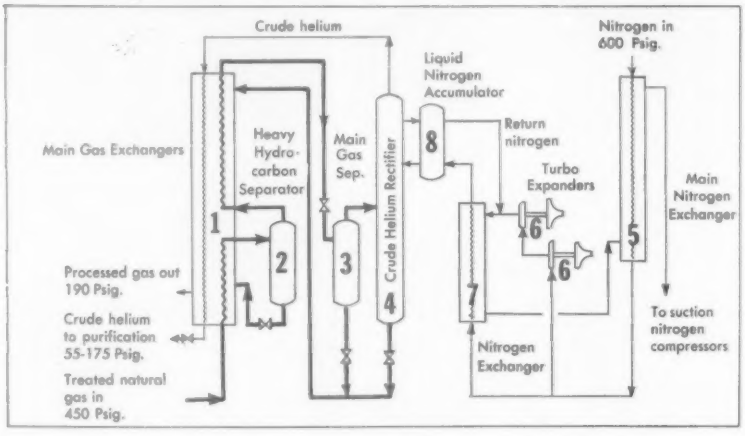
Production of helium at the Keyes plant follows the basic processing steps used at the other bureau plants. Basically, three steps are involved—gas treating, crude-helium separation, and final purification. The general processing steps and auxiliary services are shown in Fig. 3.

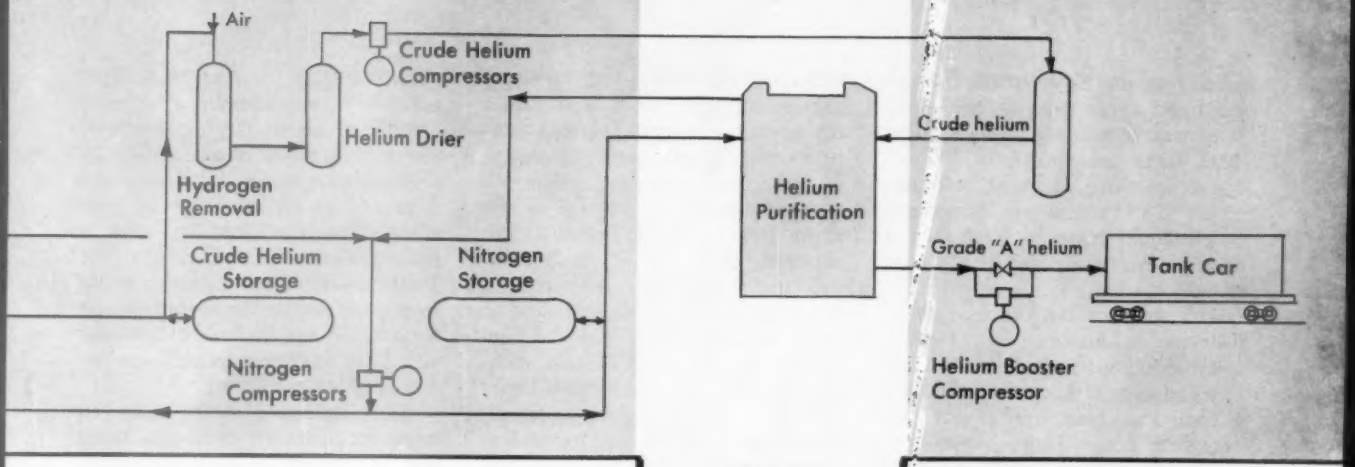
Gas treating. Helium-bearing natural gas from Keyes field enters the plant at 450-650 psig. The stream is first treated to remove carbon dioxide and water vapor prior to low-temperature processing for extraction of crude helium. Carbon dioxide is removed in a monoethanolamine-diethylene glycol treating plant.

Two 35-M.M.c.f.d. gas-treating units remove carbon dioxide and water from the inlet gas. Two units were provided to give flexibility of operation, to accommodate seasonal fluctuation in gas supply, and to permit the bureau to meet its contractual commitment of processing the minimum quantity of gas avail-



THREE UNITS make first separation of helium from natural gas. Fig. 4. Flow diagram for crude-helium separation cycle is shown below. Fig. 5.





OVER-ALL FLOW of gas through Keyes plant. Fig. 3.

able without interruption due to equipment being out of service.

The carbon dioxide-removal plant processes natural gas with an inlet carbon dioxide content of 0.75% and uses a solution composed of 16% monoethanolamine, 72% diethylene glycol, and 12% water. Although the primary purpose of the amine-glycol solution is to remove carbon dioxide, the gas is also partially dehydrated because of the high glycol content of the solution.

Further dehydration takes place in a second contactor using an amine-glycol solution having a lower water content than the first. Solution for the second contactor is obtained by regenerating a sidestream of the amine-glycol solution at a higher temperature, to remove additional water. This second solution stream is about one-tenth of the volume of the original and contains about 16% monoethanolamine, 70% diethylene glycol, and 5% water.

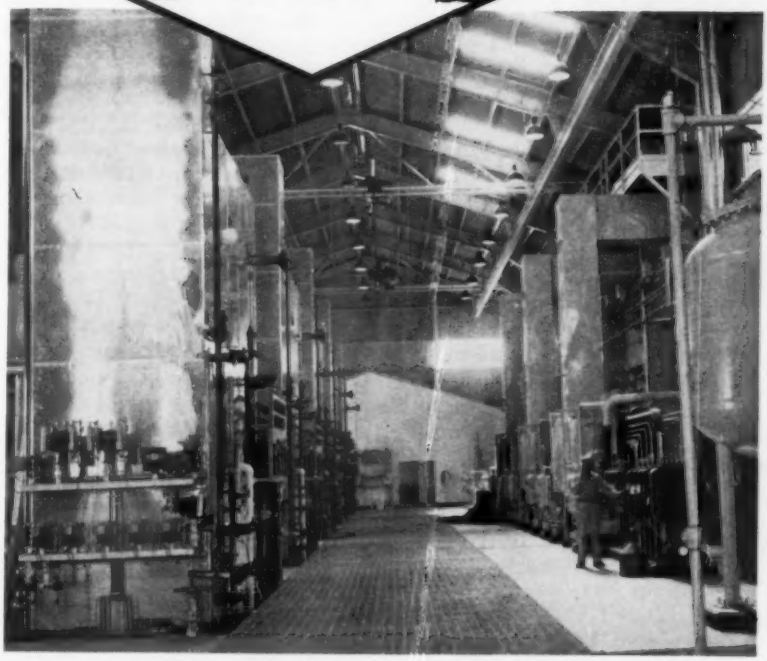
The effluent gas stream from the second contactor contains about 0.005% (50 p.p.m.) carbon dioxide and a water content of about 12 lb. per M.M.c.f.

The gas then passes through an activated bauxite-filled dehydration tower, which contains a molecular-sieve trimmer bed. Here the water content is reduced to about 0.002 lb. per M.M.c.f. or a dew point of about −100° F. at 450 psig. The natural-gas stream is then ready for low-temperature processing to separate the crude-helium product.

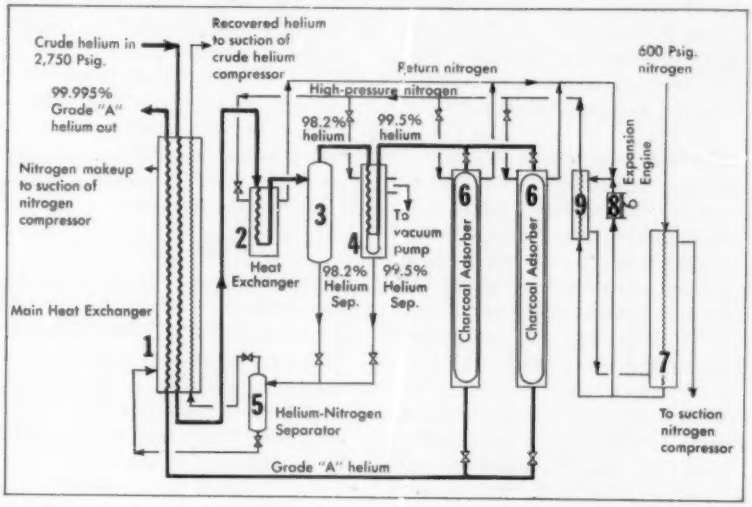
Crude-Helium Separation

The crude-helium separation

Helium Purification



FIVE HELIUM-PURIFICATION UNITS are at left in photograph above. Fig. 6. Flow diagram for purification cycle is shown below. Fig. 7.



process at the Keyes plant follows the basic cycle used at the other Bureau of Mines helium plants. The three units are shown in Fig. 4. These are three identical, self-contained units and are commonly called "cold boxes." Each has a design capacity of 23.3 M.M.c.f. of natural gas per day.

The steps of the process are illustrated schematically in Fig. 5. Treated natural gas enters the main gas exchangers, **1**, at 450 psig. and is cooled to about −60° F. It then enters a heavy-hydrocarbon separator, **2**, where the condensed heavy hydrocarbons are separated and returned to the processed gas stream.

Removal of heavy hydrocarbons prevents formation of plugs in the coldest part of the process equipment. Experience with a similar gas at the Amarillo plant had shown that certain heavy hydrocarbons could plug the low-temperature equipment if they were permitted to reach the coldest part of the equipment.

Consequently, during design of the plant, laboratory tests were made with Keyes gas, to determine temperature and pressure conditions of a heavy-hydrocarbon separator to yield a vapor phase that would not cause plugs when cooled to −250° F.

The combination of adequate gas treating and heavy-hydrocarbon separation has virtually eliminated the need for thawing the crude-helium units at the Keyes plant. The maximum time required between thawings has not been determined because other conditions have required taking units off stream before there was an indication of need for thawing. Units have been on stream without shutdown for as long as 4 months.

Further separation. After separation in the heavy-hydrocarbon separator, **2**, the vapor phase is returned to the main gas exchangers and cooled further to −250° F. by countercurrent heat exchange with the processed (outgoing stream) gas. At −250° F. and 400 psig., about 94% of the gas is condensed.

The natural-gas stream is then throttled into the main gas separator, **3**, which operates at −250° F. and 225 psig. Experimental values obtained by the Helium Activity Research Laboratory for helium content of the vapor and liquid equilibrium phases for various temperatures and pressures are shown on Page 100, preceding article.

Approximate composition of the vapor phase is 35% helium, 54% nitrogen, and 11% hydrocarbons, principally methane. Also present is about 0.1% hydrogen and a trace of neon. This vapor stream is fed into the crude-helium rectifier, **4**, which is cooled with liquid nitrogen. The liquefied hydrocarbons from **3** and **4** are throttled to the return path of the main gas heat exchangers for countercurrent heat exchange with the inlet gas.

Crude helium from the crude-helium rectifier has a composition of about 79% helium, 20.8% nitrogen, 0.1% hydrogen, and less than 0.1% hydrocarbons. The crude-helium product at about −300° F. is also returned to the main gas heat exchanger for countercurrent heat exchange with the inlet gas.

Refrigeration. Refrigeration for rectification of the crude helium is provided by a 600-psig. Claude-type nitrogen liquefaction cycle. Dry nitrogen at 600 psig. enters the main nitrogen heat exchanger, **5**, and is cooled to about −140° F. where a portion passes through two stages of expansion in turbo expansion engines, **6**. The remaining fraction is cooled further in nitrogen heat exchanger, **7**. Liquid nitrogen is formed in accumulator, **8**, by throttling nitrogen at 600 psig. from heat exchanger, **7**, down to about 1 atm.

The liquid nitrogen from accumulator, **8**, flows by gravity head into the condensing section of rectifier, **4**. Cold nitrogen vapors from the rectifier, **4**, and the accumulator, **8**, join the expansion engine exhaust and enters the return path of the nitrogen heat exchangers for countercurrent heat exchange with inlet high-pressure nitrogen.

Helium Purification

Purification of the product from the crude-helium separation units is accomplished by three additional low-temperature processing steps. Prior to purification, the hydrogen content of the crude-helium stream is reduced from about 0.1 to 0.01% by catalytic oxidation.

This step is accomplished at about 50 psig. and ambient temperature by the addition of a small amount of air to the crude-helium stream just ahead of the hydrogen-removal equipment. Addition of air is controlled automatically to consume all oxygen and to leave a hydrogen content of about 0.01%. Further, every effort has been made to prevent oxygen from getting past the catalyst bed because of the possibility of later concentration in the low-temperature system.

After reduction of the hydrogen content, the crude helium is dried with activated alumina and compressed to 2,750 psig. Lubricating oil, introduced during compression, is removed in a charcoal filter and the stream is dried again. The clean, dry, high-pressure crude helium is then fed to the purification units. The trace of hydrogen remaining after the removal step described previously serves the purpose of signaling saturation of the charcoal adsorbers used in final purification.

Hydrogen is the first significant impurity to appear in the effluent stream from the adsorbers. Detection of the first traces of hydrogen by sensitive analytical instruments, in the p.p.m. range, signals the need to switch to a regenerated charcoal adsorber.

Purification cycle. Fig. 7 shows the helium-purification cycle schematically. Crude helium at 2,750 psig. enters main heat exchanger, **1**, and is cooled by countercurrent heat exchange with three effluent streams. The sources of these streams are described later. The inlet crude-helium stream is cooled and stabilized at −320° F. in heat exchanger, **2**, by a liquid nitrogen bath. A separation is made in gas-liquid separator, **3**.

The equilibrium vapor phase has a composition of 98.2% helium, 1.8% nitrogen, 0.01% hydrogen, and a trace of neon (6 p.p.m.). The 98.2% stream is cooled to about −340° F. by means of a liquid nitrogen bath boiling at 3 psia. A second phase separation is made and the vapor phase has a composition of 99.5% helium, 0.5% nitrogen, 0.01% hydrogen, and a trace of neon.

Liquid nitrogen from the 98.2% helium separator, **3**, contains about 3.7% helium and the liquid nitrogen from the 99.5% helium sep-

arator, **4**, contains a similar amount of dissolved helium. These two liquid streams are throttled to about 50 psig. in helium-nitrogen separator, **5**, where virtually all the dissolved helium is released. The vapor phase is composed of about 37% helium and 63% nitrogen, and is returned to the main heat exchanger, **1**, and warmed by countercurrent heat exchange with inlet crude.

The 37% crude-helium stream is recycled to the suction of the crude-helium compressors and thus essentially all the helium dissolved in the liquid nitrogen is recovered. Liquid nitrogen from phase separator, **5**, is also returned to the main heat exchanger and warmed to ambient temperature by heat exchange with the inlet high-pressure crude. This stream is about 99.9% nitrogen and 0.1% helium, and is the source of makeup nitrogen for the nitrogen-refrigeration system.

Final purification. Final purification of 99.5% helium stream is accomplished by adsorption of the remaining impurities in one of the two sets of charcoal adsorbers, **6**. These adsorbers are maintained in a bath of liquid nitrogen and produce helium of at least 99.995% purity which is designated Grade A helium. From the charcoal adsorbers, the helium is returned to the main heat exchanger and is warmed to ambient temperature.

Trace impurities in samples of helium typical of normal production are: H_2, 0.8 p.p.m.; N_e, 5.4 p.p.m.; N_2, 1.5 p.p.m.; and total impurities, 7.7 p.p.m.

Liquid nitrogen for use in the purification units is also obtained from a Claude-type liquefaction cycle. Clean, dry, nitrogen at 600 psig. enters nitrogen heat exchanger, **7**, and is cooled to about −166° F. About 80% of the stream is passed through a single-stage reciprocating expansion engine, **8**. The remaining 20% goes to heat exchanger, **9**.

Liquid nitrogen is produced for the various processing steps by throttling high-pressure nitrogen from heat exchanger, **9**. The flash vapors combine with nitrogen vapors from the other equipment using liquid nitrogen, join the expansion engine exhaust (−310° F.), are returned through nitrogen exchangers, **9** and **7**, and warmed to ambient temperature by countercurrent heat exchange with the high-pressure inlet nitrogen. Fig. 6 is an interior view of the separation building showing the five purification and three crude-helium separation units.

TABLE 1—GENERAL PLANT PERFORMANCE FOR FISCAL YEAR 1960

	Monthly Average October-June
Plant shrinkage (per cent of inlet):	
Fuel	4.95
Extraction and losses	3.86
Total shrinkage	8.81
Separation efficiency, per cent	93.78
Recovery efficiency, per cent	91.02
Salable helium recovered, M.c.f. (14.7 p & s.i.a 70° F.)	26,353
Crude-helium purity, %	60-80

TABLE 2—FISCAL YEAR 1960 OPERATING COST OF KEYES HELIUM PLANT

Total investment—$11,005,390
Total helium produced—262,672,000 cu. ft.

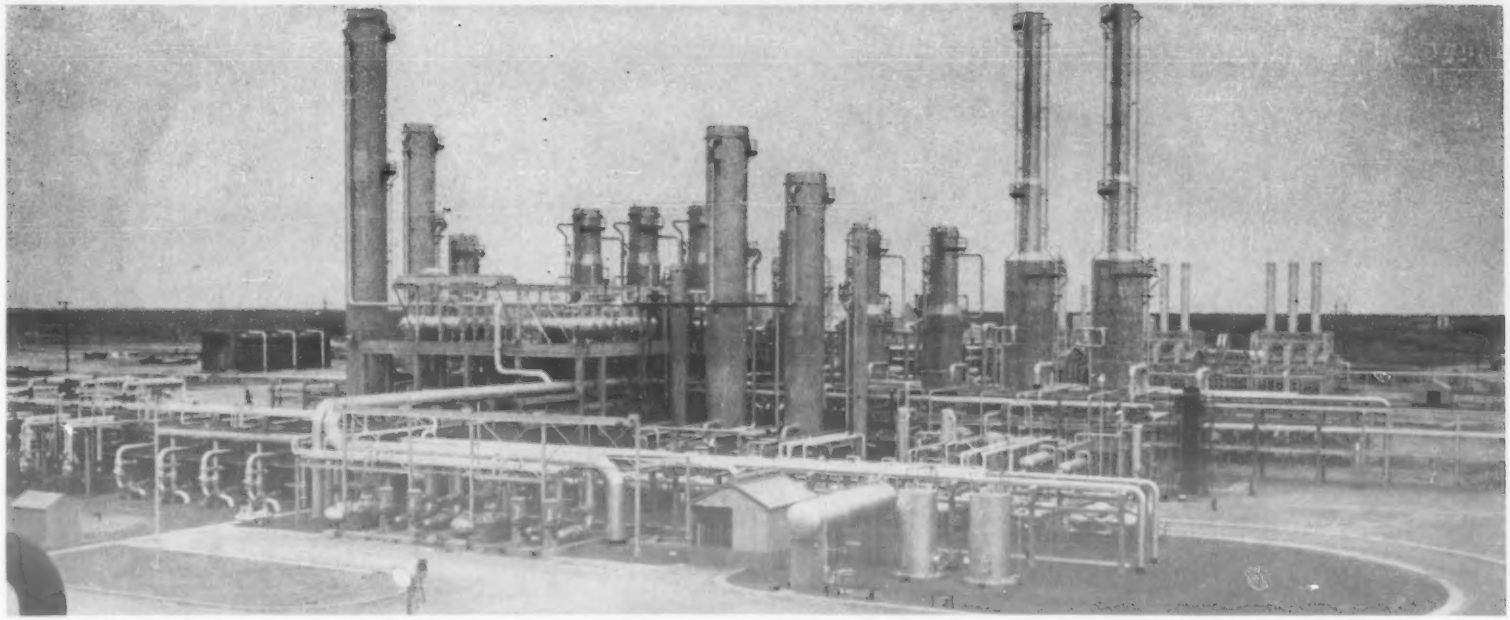
Item		Dollars
Natural-gas costs:		
Gas-processing fee to company	$584,659	
Shrinkage cost due to removal of carbon dioxide, water, nitrogen, and helium	138,199	
Fuel cost	182,154	
Subtotal		$905,012
Plant operation:		
Labor	$264,561	
Materials, supplies, etc.	143,502	
Subtotal		408,063
Plant maintenance:		
Labor	$121,730	
Materials, supplies, etc.	57,827	
Subtotal		179,557
Depreciation (for 10 months):		
Plant (20 years)	$448,801	
Camp (20 years)	12,710	
Subtotal		461,511
Plant administration:		
Supervision (salaries, materials, and supplies)	$ 42,265	
Security and civil defense (salaries, materials, and supplies)	29,235	
Subtotal		71,500
Total direct operating cost		2,025,643
Unit cost of helium produced (direct operating cost)		$7.71 per M.c.f.
Tank cars (104 cars required to ship output):		
Maintenance and testing	$ 69,748	
Depreciation (40 years)	163,534	
Subtotal		233,282
General administrative overhead		133,477
Total of all costs		$2,392,402
Unit cost of helium produced (all costs).		$9.11 per M.c.f.

Plant Performance

The Keyes plant has a natural-gas-processing capacity of 70 M.M. c.f.d. at a pressure of 450 psig. Inlet gas averages 64.2% methane and 2.1% helium, with a heat content of 817 B.t.u. per cu. ft. Outlet gas averages 66.7% methane and 0.13% helium, with a heat content of 850 B.t.u. per cu. ft.

General plant performance for fiscal year 1960 is shown in Table 2. Performance during the startup in August and September has been excluded.

During fiscal year 1960 the Keyes plant operated approximately 330 days (startup August 2, 1959) and produced 263 M.M.c.f. of helium at an average cost of $9.11 per M.c.f.



ADDING A HEFTY 800 M.M.c.f. daily to the industry's gas-processing capacity is Humble's King Ranch plant in Texas, completed late 1960.

Journal Survey of Gas-Processing Plants in the United States

State Capacities as of January 1, 1961, and Average Production

State—	No. plants	M.M.c.f. daily Capacity	M.M.c.f. daily Throughput	Production—Gallons Daily Propane	Isobutane	Normal Butane	LPG Mix	Combined Gaso.-LPG	Natural Gasoline	Other	Total Products
Arkansas	7	439.0	321.1	111,162	29,179	40,223	6,266		68,835	14,108	269,773
California	63	2,168.0	1,530.3	805,880	81,146	235,990	85,196	278,240	1,916,831		3,403,283
Colorado	15	513.0	275.0	175,404		92,106	21,260	114,771	116,968		520,509
Illinois	4	573.8	539.7	609,079	5,000	76,000	8,942		63,839	4,000	766,860
Kansas	13	1,840.0	1,444.0	156,467	28,300	137,054	21,100		318,819		661,740
Kentucky	7	971.2	916.1	160,000		52,000	365,000	1,270	83,000		661,270
Louisiana	81	7,711.3	6,011.5	830,360	177,006	321,472	149,361	1,280,000	1,923,414	639,465	5,321,078
Michigan	2	37.0	21.3	29,459			6,000	26,087			61,546
Mississippi	4	260.0	250.3	26,710		6,222	5,484		54,958		93,374
Montana	2	67.5	29.0	6,200			7,800	42,000	6,500		62,500
Nebraska	5	77.5	68.9	91,438		38,952			49,177		179,567
New Mexico	37	2,641.9	2,102.2	904,238	34,800	741,032	240,992	497,085	778,964		3,197,111
North Dakota	1	65.0	48.7	84,000		50,000			30,000		164,000
Oklahoma	72	2,955.0	2,228.0	1,342,493	77,248	373,639	276,803	637,411	1,381,824		4,089,418
Pennsylvania	4	24.0	18.3	4,000		2,000			4,619		10,619
Texas	270	18,854.2	14,164.0	4,687,636	752,424	2,430,281	910,311	6,298,580	6,254,802	1,883,992	23,218,026
Utah	3	160.0	109.0						11,985		11,985
West Virginia	30	592.0	308.9	53,023		53,235	43,200		69,379		218,837
Wyoming	13	570.5	426.7	204,854	6,000	115,325		106,100	124,507		556,786
Total	633	40,520.9	30,813.0	10,282,403	1,191,103	4,765,531	2,147,715	9,281,544	13,258,421	2,541,565	43,468,282

Plant Capacities January 1, 1961, and Average Production

Products listed in the last column are identified by numbers:

1. Ethane
2. Ethane-propane mix
3. Isopentane
4. Normal pentane
5. Upgraded motor fuel
6. Solvent naphtha
7. Jet fuel
8. Diesel
9. Kerosine
10. Light residuum
11. Diesel, kerosine, and bottoms

NR means not reported. To arrive at more accurate state totals, throughput is estimated at 80% of capacity when such figures are not reported.

Arkansas

Company, Plant, and Location (★ indicates cycling)	Nearest Town	M.M.c.f. daily Capacity	M.M.c.f. daily Throughput	Process Method	Production—Gallons Daily Propane	Isobutane	Normal Butane	LPG Mix	Combined Gaso.-LPG	Natural Gasoline	Other
Arkansas Louisiana Chemical Corp.											
Hamilton plant, various fields, Columbia County	Magnolia	350.0	252.0	Refr.-abs.	88,900	20,000	21,500	.....	.....	19,000	[3]9,500
Lion Oil Co.											
★Schuler Unit, Union County	El Dorado	26.0	13.3	Abs.	818	.....	.....	4,066	.....	5,447	.....
McKamie Gas Cleaning Co.											
★Lerch plant, McKamie-Patton field, Lafayette County	Stamps	55.0	50.9	Abs.	18,090	9,179	14,046	.....	.....	32,888	.....
Mobil Oil Co. (plant sold to Denton Corp.)											
Kenova plant, Smackover field, Union County*	Smackover	3.0	2.0	Abs.	.....	.....	.....	2,200	.....	6,500	.....
Querbes Oil Co., J. R.											
Helwig plant, South field, Union County	El Dorado	2.0	1.0	Comp. & Abs.	.....	.....	.....	.....	.....	5,000	.....
Shell Oil Co.											
Magnolia field, Columbia County	Magnolia	(Operation discontinued mid-1960.)									
Sunray Mid-Continent Oil Co.											
Midway field, Lafayette County	Lewisville	3.0	1.9	Abs.	3,354	.....	4,677	.....	.....	.....	[3]1,179 †3,429
Total‡		439.0	321.1		111,162	29,179	40,223	6,266	.....	68,835	14,108

*Figures are from 1960 survey. †Type not reported. ‡Normal butane total includes butanes that are not split.

California

Company, Plant, and Location (★ indicates cycling)	Nearest Town	M.M.c.f. daily Capacity	M.M.c.f. daily Throughput	Process Method	Production—Gallons Daily Propane	Isobutane	Normal Butane	LPG Mix	Combined Gaso.-LPG	Natural Gasoline	Other
Belridge Oil Co.											
★Belridge field, Kern County	McKittrick	80.0	60.0	Abs.	13,000	2,600	.....	.....	.....	25,700	.....
Brea Canon Oil Co.											
Brea field (production as reported in previous surveys)	.....	NR	NR	NR	.....	.....	.....	15,000	.....	.....	.....
Coline Gasoline Corp.											
★Rincon field, Ventura County	Ventura	20.0	15.0	Refr.-abs.	16,500	4,900	4,900	.....	.....	16,500	.....
Continental Oil Co.											
San Miguelito plant, Ventura field, Ventura County	Ventura	23.0	15.9	Refr.-abs.	21,699	.....	.....	.....	29,760	.....	.....
Gulf Oil Corp.											
★Paloma field, Kern County	Bakersfield	150.0	128.0	Abs.	83,596	.....	54,636	.....	.....	*125,017	.....
Honolulu Oil Corp.											
Buena Vista Hills field, Kern County	Taft	16.0	13.3	Comp. & abs.	4,544	.....	.....	.....	.....	19,950	.....
Cymric field, Kern County	Taft	40.0	11.4	Comp. & abs.	6,765	.....	.....	8,756	.....	24,277	.....
Inglewood Gasoline Co.											
Potrero field, Los Angeles County	Inglewood	10.0	9.0	Abs.	48	30	19	3,840		8,200	

Company, Plant, and Location (★ indicates cycling)	Nearest Town	M.M.c.f. daily Capacity	M.M.c.f. daily Throughput	Process Method	Production—Gallons Daily Propane	Isobutane	Normal Butane	LPG Mix	Combined Gaso.-LPG	Natural Gasoline	Other
CALIFORNIA (Continued)											
Lomita Gasoline Co.											
Long Beach field, Los Angeles County	Long Beach	60.0	15.0	Abs.	11,000	.....	.....	.....	.....	72,000	.....
Magruder, P. S.											
Huffman plant, Kettleman Hills field, Fresno County	(See Standard of California listing.)										
Western States plant, Kettleman Hills field, King County	(See Standard of California listing.)										
Mobil Oil Co.											
Burrel plant, Helm field, Fresno County	Burrel	25.0	5.7	Abs.	4,650	.....	2,700	.....	.....	5,700	.....
Santa Fe Springs field, Los Angeles County	Santa Fe Spgs.	24.0	4.7	Abs.	.....	.....	.....	.....	44,200	.....	.....
Wilmington field, Los Angeles County	Wilmington	50.0	20.0	Abs.	.....	.....	.....	.....	131,480	.....	.....
Monterey Oil Co.											
Huntington Beach field, Orange County	Huntington Beach	12	2.6	Abs.	1,893	.....	.....	.....	.....	19,230	.....
Ohio Oil Co.											
★South Coles Levee field, Kern County	Bakersfield	80.0	77.6	Abs.	14,146	8,493	9,589	.....	.....	29,610	.....
Richfield Oil Corp.											
East Los Angeles field, Los Angeles County	Los Angeles	(Plant dismantled.)									
North Coles Levee field, Kern County	Tupman	160.0	165.0	Abs. & Refr.-abs.	47,000	.....	.....	.....	.....	119,000	.....
Rincon field, Ventura County†	Ventura	4.0	...	Refr.	.....	.....	.....	.....	6,500	.....	.....
Russell Ranch field, San Luis Obispo County	Cuyama	18.0	15.0	Abs.	11,000	.....	11,000	.....	.....	18,000	.....
South Cuyama field, Santa Barbara County	Cuyama	80.0	78.0	Abs. & Refr.-abs.	43,000	15,000	13,000	1,000	.....	44,000	.....
Shell Oil Co.											
Brea plant, Brea-Olinda field, Los Angeles County	Brea	25.0	9.3	Abs.	.....	.....	.....	.....	.....	45,000	.....
Long Beach plant, Signal Hill field, Los Angeles County	Long Beach	8.0	3.9	Abs.	.....	.....	.....	.....	.....	31,500	.....
Ten Section field, Kern County	Bakersfield	65.0	45.0	Abs.	49,000	9,000	19,000	.....	.....	35,500	.....
Ventura Avenue field, Ventura County	Ventura	147.0	103.0	Abs.	28,000	.....	.....	.....	.....	286,500	.....
Signal Oil & Gas Co.											
Ellwood field, Santa Barbara County	Goleta	15.0	3.2	Abs.	1,000	.....	.....	300	.....	4,500	.....
Huntington Beach field, Orange County	Huntington Beach	50.0	29.0	Refr.-abs.	25,000	.....	.....	1,000	.....	90,000	.....
Maricopa field, Kern County	Maricopa	10.0	4.7	Abs.	.....	.....	.....	.....	.....	7,100	.....
Signal Hill-Wilmington field, Los Angeles County	Long Beach	40.0	15.5	Refr.-abs.	10,000	.....	.....	.....	.....	35,000	.....
Standard Oil Co. of California, Western Operations, Inc.											
Carpinteria Compression plant, Summerland field, Santa Barbara County	Carpinteria	10.0	7.0	Refr. & Comp.	.....	.....	.....	.....	.....	6,300	.....
Colonia Vapor plant, Montalvo West field, Ventura County	Oxnard	1.0	1.0	Comp.	.....	.....	.....	.....	.....	10,700	.....
Gaviota stabilization facility, Ventura County	Gaviota	10.0	9.0	Refr.	.....	.....	.....	.....	.....	15,400	.....
★Greeley field, Kern County	Bakersfield	25.0	21.0	Abs.	18,000	.....	.....	11,900	.....	17,400	.....
Huffman plant, Kettleman Hills field, Fresno County (formerly operated by P. S. Magruder)	Avenal	50.0	45.0	Refr.-abs.	28,600	8,800	14,300	.....	.....	38,000	.....
Huntington Beach field, Orange County	Huntington Beach	15.0	8.0	Abs.	5,400	.....	.....	.....	.....	25,700	.....
Inglewood field, Los Angeles County	Inglewood	15.0	10.0	Abs.	.....	.....	.....	.....	20,400	.....	.....
★Kettleman Hills 3-P, 11-P, and 33-J plants, Kings and Fresno counties	Avenal	140.0	71.0	Abs.	27,400	6,900	2,900	9,700	.....	57,000	.....
Lost Hills field, Kern County	Bakersfield	3.5	3.0	Abs.	.....	.....	.....	.....	2,800	.....	.....
Midway 1-C, 7-D, and 29-G plants, Kern County	Taft	52.0	47.0	Abs.	19,300	.....	.....	.....	.....	70,000	.....
Mountain View field, Kern County	Bakersfield	17.0	8.4	Abs.	.....	.....	.....	.....	.....	16,100	.....
★Murphy Coyote plant, Coyote Hills field, Orange County	La Habra	50.0	36.0	Abs.	13,000	.....	.....	.....	.....	38,500	.....
Naval Petroleum Reserve No. 1, Elk Hills field, Kern County	Tupman	4.0	2.0	Abs.	.....	.....	.....	.....	.....	2,080	.....
Northeast Coalinga plant, Coalinga field, Fresno County	Coalinga	40.0	1.7	Comp.	.....	.....	.....	.....	.....	2,100	.....
Santa Fe Springs field, Los Angeles County	Santa Fe Spgs.	5.0	2.0	Abs.	.....	.....	.....	.....	.....	12,200	.....
Seal Beach field, Orange County	Seal Beach	22.0	17.0	Abs.	.....	.....	.....	.....	43,100	.....	.....
Torrance field, Los Angeles County	Torrance	6.0	3.0	Abs.	.....	.....	.....	.....	.....	7,300	.....

Company, Plant, and Location (★ indicates cycling)	Nearest Town	M.M.c.f. daily Capacity	M.M.c.f. daily Throughput	Process Method	Production—Gallons Daily Propane	Isobutane	Normal Butane	LPG Mix	Combined Gaso.-LPG	Natural Gasoline	Other
CALIFORNIA (Continued)											
Western States plant, Kettleman Hills field, Kings County (formerly operated by P. S. Magruder)	Avenal	65.0	55.0	Refr.-abs.	28,500	7,100	6,800	.....	.....	45,000	.....
Sunray Mid-Continent Oil Co.											
★Newhall plant, Newhall-Potrero field, Los Angeles County	Los Angeles	40.0	49.0	Abs.	28,684	.....	10,797	.....	.....	22,372	.....
Superior Oil Co.											
Rio Bravo field, Kern County	Shafter	30.0	23.0	Abs.	36,655	5,323	19,049	.....	.....	17,595	.....
Texaco Inc.‡											
Honor Rancho plant, Los Angeles County	Castaic	18.0	NR	Abs.	12,000	.....	16,000	.....	.....	16,000	.....
Santa Fe Springs field, Los Angeles County	Santa Fe Spgs.	12.0	NR	Abs.	4,000	.....	.....	.....	.....	35,000	.....
Shiells Canyon plant, Ventura County	Fillmore	32.0	NR	Abs.	18,000	.....	17,000	.....	.....	33,000	.....
Signal Hill plant, Los Angeles County	Signal Hill	30.0	NR	Abs.	15,000	.....	.....	.....	.....	75,000	.....
Tidewater Oil Co.											
★Ventura No. 2 plant, Ventura Avenue field, Ventura County	Ventura	75.0	66.0	Abs.	55,000	13,000	12,300	1,500	.....	63,000	.....
Union Oil Co. of California											
Belgian Anticline field, Kern County	Taft	3.0	1.3	Refr.-abs.	.....	.....	.....	.....	.....	3,000	.....
Bell plant, Santa Fe Springs field, Los Angeles County	Whittier	9.5	9.1	Abs.	.....	.....	.....	.....	.....	36,800	.....
★Coalinga Nose field, Fresno County	Coalinga	32.0	22.1	Abs.	19,000	.....	.....	22,500	.....	22,000	.....
Del Vallefield, Los Angeles County	Santa Paula	32.0	20.5	Refr.-abs.	21,000	.....	.....	9,700	.....	18,500	.....
Dominguez field, Los Angeles County	Compton	22.0	17.6	Abs.	16,500	.....	.....	.....	.....	44,000	.....
Santa Maria field, Santa Barbara County	Santa Maria	35.0	26.4	Abs.	25,700	.....	22,000	.....	.....	35,600	.....
Stearns plant, Brea-Olinda field, Orange County	Brea	25.0	18.6	Abs.	22,300	.....	.....	.....	.....	41,900	.....
West Coast Refining Co.											
Richfield field, Orange County	Placentia	30.0	5.0	Abs.	.....	.....	.....	.....	.....	27,000	.....
Totals§		2,168.0	1,530.3		805,880	81,146	235,990	85,196	278,240	1,916,831	.....

*Includes heavier ends. †Figures for this new plant are design capacity. ‡All figures are capacity. §Normal butane total includes butanes that are not split.

Colorado

California Co.											
Rangely field, Rio Blanco County*	Rangely	73.5	73.5	Abs.	28,094	.....	.....	21,260	†47,000	48,292	.....
Continental Oil Co.											
Little Beaver field, Washington County	Brush	12.0	6.0	Refr.	25,292	.....	13,192	.....	.....	13,053	.....
El Paso Natural Gas Co.											
Ignacio plant, La Plata County	Durango	300.0	102.0	Abs.	31,600	.....	45,500	.....	.....	31,100	.....
Ginther Gasoline Plants, N. C.											
★Akron field, Washington County	Akron	2.0	1.0	Refr.	1,337	.....	969	.....	.....	1,874	.....
★Goodrich plant, Bison field, Morgan County	Goodrich	12.0	11.0	Refr.-abs.	13,250	.....	.....	.....	22,624	.....	.....
★Leader field, Adams County	Last Chance	3.0	1.0	Refr.-abs.	877	.....	.....	.....	1,206	.....	.....
★Lewis Creek field, Logan County	Peetz	5.5	5.5	Refr.-abs.	2,070	.....	.....	.....	4,886	.....	.....
★Little Hoot field, Logan County	Sterling	5.0	4.5	Refr.	4,220	.....	.....	.....	3,955	.....	.....
★Padroni field, Logan County	Sterling	9.0	8.0	Refr.-abs.	2,890	.....	1,644	.....	.....	943	.....
★Vallery field, Morgan County	Fort Morgan	5.0	5.0	Refr.-abs.	1,299	.....	3,065	.....	.....	6,558	.....
★Yenter field, Logan County	Sterling	20.0	11.0	Refr.-abs.	16,375	.....	16,736	.....	.....	8,947	.....
Loffland Co.											
Fort Morgan field, Morgan County	Fort Morgan	8.0	7.0	Refr.	5,000	.....	3,000	.....	.....	4,000	.....
Mountain Fuel Supply Co.											
Hiawatha field, Moffat County	Craig	15.0	13.0	Refr.	.....	.....	.....	.....	.....	‡1,000	.....
Powder Wash field, Moffatt County	Craig	15.0	6.5	Refr.	.....	.....	.....	.....	.....	‡1,201	.....
Pure Oil Co.											
Adena field, Morgan County	Fort Morgan	28.0	20.0	Refr. & Comp.	43,100	.....	8,000	.....	35,100	.....	.....
Total		513.0	275.0		175,404	.....	92,106	21,260	114,771	116,968	.....

*Includes six remote plants. †Estimated production from the four remote plants completed in November 1960. ‡Includes heavier ends.

Company, Plant, and Location (★ indicates cycling)	Nearest Town	M.M.c.f. daily Capacity	M.M.c.f. daily Through-put	Process Method	Production—Gallons Daily Propane	Isobutane	Normal Butane	LPG Mix	Combined Gaso.-LPG	Natural Gasoline	Other
Illinois											
National Petro-Chemicals Corp.											
Tuscola plant, Douglas County*	Tuscola	560.0	528.7	NR	548,000	.....	65,000	.....	.....	27,000	.....
Texaco Inc.†											
Hoodville plant, Hamilton County	McLeansboro	7.0	NR	Abs.	43,000	5,000	11,000	.....	.....	14,000	24,000
Salem plant, Marion County	Salem	3.0	NR	Refr.	5,000	.....	.....	.....	.....	15,000	.....
Warren Petroleum Corp.											
Crossville plant, White County		NR	3.0	Abs.	13,079	.....	.....	8,942	.....	7,839	.....
Total‡		573.8	539.7		609,079	5,000	76,000	8,942	.....	63,839	4,000

*Figures from 1960 survey. †All figures are capacity. ‡Normal butane total includes butanes that are not split.

Kansas											
Cities Service Petroleum Co.											
Burrton-Stone field, Reno County	Burrton	(Shut down June 1, 1960)									
Wichita plant (transmission line), Sedgwick County	Wichita	120.0	118.0	Abs.	34,000	13,000	26,000	.....	.....	40,000	.....
Colorado Interstate Gas Co.											
Lakin plant, Hugoton field, Kearny County	Lakin	215.0	79.0	Abs.	.....	.....	.....	.....	.....	15,944	.....
Hugoton Production Co.											
Hugoton field, Grant County	Ulysses	90.0	67.0	Abs.	18,180	.....	17,592	.....	.....	15,727	.....
Kansas-Nebraska Natural Gas Co., Inc.											
Hugoton field, Kearny County	Deerfield	125.0	100.0	Abs.	3,000	.....	.....	3,000	.....	15,000	.....
Mobil Oil Co.											
Hickock plant, Hugoton field, Stephens County	Ulysses	100.0	85.0	Abs.	11,000	.....	7,000	.....	.....	25,000	.....
Spivey plant, Spivey-Grabs field, Harper County	Attica	55.0	44.0	Abs.	20,000	.....	9,000	.....	.....	23,000	.....
Northern Natural Gas Co.											
Holcomb plant, Hugoton field, Finney County	Holcomb	185.0	167.0	Refr.	.....	.....	.....	.....	.....	15,000	.....
Sublette plant, Hugoton field, Seward County	Sublette	325.0	296.0	Abs.	.....	.....	.....	.....	.....	55,000	.....
Pan American Petroleum Corp.											
Ulysses plant, Hugoton field, several counties	Ulysses	325.0	202.0	Abs.	44,800	15,300	51,900	5,100	.....	55,400	.....
Panhandle Eastern Pipe Line Co.											
Hugoton field, Seward County	Liberal	240.0	238.0	Abs.	14,487	.....	25,562	.....	.....	58,748	.....
Skelly Oil Co.											
Medicine Lodge plant, various fields, Barber County	Medicine Lodge	60.0	NR	Abs.	11,000	.....	.....	13,000	.....	.....	.....
U. S. Bureau of Mines											
Otis helium plant	(One of five government helium plants in U. S.)										
Total*		1,840.0	1,444.0		156,467	28,300	137,054	21,100	.....	318,819	.....

*Normal butane total includes butanes that are not split.

Kentucky											
Ashland Oil & Refining Co.											
Big Sinking field, Lee County	Fixer	0.7	0.4	NR	.....	.....	.....	.....	1,100	.....	.....
Martha field, Johnson County	Martha	5.5	0.7	NR	.....	.....	.....	.....	170	.....	.....
Columbia Hydrocarbon Corp.											
Siloam fractionator*	South Shore	.....	.....	.....	160,000	.....	52,000	.....	.....	20,000	.....
Kentucky West Virginia Gas Co.											
Dwale plant, Floyd County	Prestonburg	40.0	25.0	Abs.	.....	.....	.....	.....	.....	3,000	.....
Tennessee Gas Pipeline Co.											
Gabe plant		925.0	890.0	NR	.....	.....	.....	365,000	.....	60,000	.....
United Fuel Gas Co.											
Leach plant, Boyd County	Catlettsburg	(Reported as shut down in 1960)									
Warfield plant, Martin County	Warfield	(Reported as shut down in 1960)									
Total		971.2	916.1		160,000	.....	52,000	365,000	1,270	83,000	.....

*Fractionates stream from United Fuel's Kenova, W. Va., extraction plant.

Louisiana

Company, Plant, and Location (★ indicates cycling)	Nearest Town	M.M.c.f. daily Capacity	M.M.c.f. daily Through-put	Process Method	Production—Gallons Daily Propane	Isobutane	Normal Butane	LPG Mix	Combined Gaso.-LPG	Natural Gasoline	Other
Acadia Corp.											
★ Several fields, Acadia Parish	Crowley	130.0	120.0	Abs.	27,500		27,000			80,000	[8-9]37,000
Aluminum Co. of America											
Section 33 field, St. Martin Parish	St. Martinville	33.0	14.0	Ads.						1,175	
Amerada Petroleum Corp.											
Lake Chico plant, St. Martin Parish	Baton Rouge	2.5	1.3	Abs.					1,406		
Leleux plant, Vermilion Parish	Crowley	20.0	9.9	Abs.					16,728		
Anchor Gasoline Corp.											
East Krotz Springs plant, Pointe Coupee Parish	Krotz Springs	25.0	NR	Abs.					17,000		
Eola plant, Avoyelles Parish	Eola	15.0	NR	Abs.					10,000		
Tepetate field, Acadia Parish	Eunice	27.0	NR	Abs.					14,000		
Anse La Butte Gasoline Co.											
Anse La Butte field, St. Martin Parish	Lafayette	10.0	6.0	Abs.						3,500	
Arkansas Louisiana Chemical Corp.											
Ada-Bistineau field, Webster Parish	Heflin	60.0	45.0	Abs.				8,600		*17,800	[9]400
North Ruston field, Lincoln Parish	Ruston	50.0	30.0	Refr.-abs.	8,600			14,000		8,700	[10]21,200
Rodessa field, Caddo Parish	Rodessa	5.0	5.0	Abs.				2,900		7,000	
Sligo field, Bossier Parish	Haughton	60.0	50.0	Abs.				11,000		*17,000	[8]300
Atlantic Refining Co.											
Neale field, Beauregard Parish	Merryville	22.0	20.1	Abs.	11,342		8,310			7,090	
Austral Oil Co., Inc.											
Holly Beach field, Cameron Parish	Cameron	14.0	14.0	Ads.						*2,772	
South Lake Arthur field, Jefferson Davis Parish	Lake Arthur	25.0	25.0	Ads.						*1,533	
Bell Oil Co.											
North Elton field, Allen Parish	Elton	40.0	30.0	Abs.				3,000		12,000	[8]400
Brown, Herman & George R.											
Abbeville field, Vermilion Parish	Abbeville	10.0	4.0	Ads.						200	
California Co.											
Hico-Knowles field, Lincoln Parish	Ruston	75.0	40.0	Abs.	15,090			8,417			[5]26,267 [9]1,684 [10]1,730
★ Lake St. John field, Tensas Parish	Waterproof	125.0	125.0	Abs.	38,581					63,466	
Cities Service Petroleum Co.											
Bourg field, Terrebonne Parish	Houma	60.0	55.0	Ads.						*3,150	
Greenwood-Waskom field, Caddo Parish	Shreveport	6.5	4.5	Ads.						*840	
★ Langston plant, Homer field, Claiborne Parish	Homer	0.6	0.4	Comp.						3,600	
Claiborne Gasoline Co.											
Lisbon and Sugar Creek fields, Claiborne Parish	Homer	100.0	NR	Refr.-abs.	15,000			50,000		30,000	[5]60,000
Continental Oil Co.											
Louisiana Gas System plant, Calcasieu Parish†	Lake Charles	100.0	100.0	Refr.-abs.					90,000		[1]13,000
Ville Platte field, Evangeline Parish	Ville Platte	115.0	32.3	Refr.-abs.	24,680				31,752		
Cotton Valley Operators Committee											
★ Cotton Valley field, Webster Parish	Cotton Valley	‡220.0	NR	Refr.-abs.	115,290	26,250	33,516			63,336	[1]120,000 [7]72,450 [8]12,600 [9]1,134
Goliad Corp.											
Cow Island plant, Vermilion Parish	Kaplan	450.0	391.0	Refr.-abs.	(Liquids fractionated at Riverside plant listed below.)						
Riverside fractionator for Cow Island plant, Ascension Parish	Geismar	....	....	.....	60,422	27,027	24,336			34,240	
Gulf Oil Corp.											
★ Krotz Springs field, St. Landry Parish	Krotz Springs	100.0	60.0	Abs.	54,196		30,879			*221,628	
Haynesville Operators Committee											
Pettit field, Claiborne Parish	Haynesville	22.5		(Shut down in 1960.)							

Company, Plant, and Location (★ indicates cycling)	Nearest Town	M.M.c.f. daily Capacity	M.M.c.f. daily Through-put	Process Method	Production—Gallons Daily Propane	Isobutane	Normal Butane	LPG Mix	Combined Gaso.-LPG	Natural Gasoline	Other
LOUISIANA (Continued)											
Humble Oil & Refining Co., Humble Division											
Opelousas plant, St. Landry Parish	Opelousas	190.0	173.7	Refr.-abs.	40,566	23,371	20,771			45,104	
Hunt Oil Co.											
Clear Creek field, Beauregard Parish	Reeves	10.0	6.7	Refr.-abs.	13,400		8,600			5,600	
La Gloria Oil & Gas Co.											
Rayne field, Acadia Parish	Rayne	150.0	124.0	Refr.-abs.					131,400		
Mississippi River Fuel Corp.											
Perryville field, Morehouse Parish	Monroe	300.0	300.0	Abs.					5,500		
Mobil Oil Co.											
Cameron Meadows central separator facilities, Cameron Parish	Johnsons Bayou	150.0	61.0	Abs.					108,594		
Hurricane Creek field, Beauregard Parish	Lake Charles	4.0	3.3	Refr.				6,000		7,500	
Mamou field, Evangeline Parish	Mamou	7.0	4.2	Abs.				6,000		8,000	
★ Opelousas field, St. Landry Parish	Opelousas	23.0	26.0	Refr.-abs.				15,000		*73,000	
Pan American Petroleum Corp.											
Big Lake field, Cameron Parish	Cameron	17.5	15.6	Ads.					1,932		
Church Point field, Acadia Parish	Church Point	5.0	2.7	Ads.					210		
Lake Sand field, Iberia Parish	Franklin	30.0	28.5	Ads.					3,150		
Lewisburg field, St. Landry Parish	Lewisburg	10.0	5.9	Ads.					806		
★ South Jennings plant, Jennings field, Jefferson Davis Parish	Jennings	55.0	49.0	Abs.				4,200		26,600	[9]10,900 [11]5,800
South Pecan Lake field, Cameron Parish	Cameron	110.0	88.5	Ads.					11,592		
Phillips Petroleum Co.§											
Vermilion plant, North Erath field, Vermilion Parish	Erath	45.0	NR	Abs.	9,000		6,000			10,000	
Placid Oil Co.											
Lake Washington field, Plaquemines Parish	Port Sulphur	40.0	24.7	Ads.						2,630	
Thibodaux field, La Fourche Parish	Thibodaux	9.0	9.0	Ads.						946	
Runnels Gas Products Co. (see Union Texas)											
Shell Oil Co.											
Iowa field, Jefferson Davis Parish	Iowa	70.0	33.0	Abs.						35,000	
★ Weeks Island field, Iberia Parish	Weeks	128.0	130.0	Abs.	10,000					*223,000	
Sohio Petroleum Co.											
★ Washington field, St. Landry Parish	Opelousas	42.0	42.0	Abs.	28,000	12,000	10,000			*92,400	
Southern Natural Gas Co.											
Toca plant, St. Bernard Parish	Chalmette	300.0	225.0	Ads.						21,396	
Southwest Gas Producing Co., Inc.											
Jeanerette field, St. Mary Parish	Jeanerette	25.0	15.0	Ads.						750	
North Starks field, Calcasieu Parish	Starks	15.0	8.0	Ads.						1,430	
Southwest-Feazel Calhoun plant, Calhoun field, Ouachita Parish	Monroe	75.0	25.0	Refr.-abs.					[8](150,000)		
Southwest-Feazel Dubach plant, various fields, Lincoln Parish (also separates condensate from Calhoun plant listed above)	Dubach	190.0	80.0	Refr.-abs.	60,000	15,000	32,000				[12]5,000 [8]155,000 [10]22,500
Sun Oil Co.											
Delhi field, Richland Parish		14.4	11.0	Refr.-abs.	17,231	4,608	9,123			13,711	[3]3,355
Sunray Mid-Continent Oil Co.											
★ Benton field, Bossier Parish	Benton	60.0	55.0	Refr.-abs.	16,721		9,434			17,431	[7]12,246 [8]5,615 [11]11,246
★ Northwest Branch field, Acadia Parish	Branch	30.0	30.0	Abs.	11,938		6,385			*40,000	
★ Shoats Creek field, Beauregard Parish	DeQuincy	7.0	7.0	Refr.				4,233			
★ South Sarepta field, Bossier Parish	Sarepta	25.0	22.0	Abs.	10,251			6,811		50,290	
★ West Tepetate field, Jefferson Davis Parish	Elton	18.0	7.0	Abs.					5,930		
Superior Oil Co.											
Bayou Penchant field, Terrebonne Parish	Houma	75.0	60.0	Ads.						6,500	
Bayou Ramio field, Terrebonne Parish	Houma	25.0	5.5	Ads.						800	

Company, Plant, and Location (★ indicates cycling)	Nearest Town	M.M.c.f. daily Capacity	M.M.c.f. daily Throughput	Process Method	Production—Gallons Daily Propane	Isobutane	Normal Butane	LPG Mix	Combined Gaso.-LPG	Natural Gasoline	Other
LOUISIANA (Continued)											
Four Isle Dome field, Terrebonne Parish	Houma	75.0	50.0	Ads.						5,600	
Lowry plant, Cameron Parish	Lake Arthur	300.0	230.0	Refr.-abs.	57,552	26,750	17,618			36,713	[11]888
Texaco Inc.§											
★ Bateman Lake plant, St. Mary Parish	Berwick	145.0	NR	Abs.	8,000					135,000	
★ Erath plant, Vermilion Parish	Erath	220.0	NR	Abs.	50,000		56,000			*290,000	[3]18,000
Paradis plant, St. Charles Parish	Paradis	320.0	NR	Abs. & refr.	93,000	42,000				124,000	
Tidewater Oil Co.											
East Bastian Bay field, Plaquemines Parish‖	Buras	120.0	74.8	Ads.						7,924	
Hollywood field, Terrebonne Parish	Houma	75.0	75.0	Refr.-abs.	19,000		10,500			12,000	
Opelousas field, St. Landry Parish	Opelousas	16.0	11.5	Ads.						2,353	
Venice field, Plaquemines Parish	Venice	55.0	42.0	Refr.-abs.	15,000		11,000			10,000	
Union Oil Co. of California											
Common Plant No. 2, Houma field, Terrebonne Parish	Houma	40.0	30.0	Ads.						2,772	
Union Texas Natural Gas Co.											
Eunice plant, Acadia Parish (formerly listed as Runnels Gas Products Corp.)	Eunice	NR	800.0	Refr.-abs.					450,000		
Rayne plant, Acadia Parish	Rayne	NR	700.0	Refr.-abs.					300,000		
Toca plant, St. Bernard Parish	New Orleans	NR	143.0	Refr.-abs.					80,000		
United Gas Pipe Line Co.											
Koran plant, Sligo and Bistineau fields, Bossier and Webster parishes	Haughton	93.5	73.0	Abs.				6,200		*22,300	[9]750
Rodessa field, Caddo Parish	Vivian	16.5	8.0	Abs.				3,000		7,200	
Warren Petroleum Corp.											
Homer plant, Claiborne Parish		NR	1.0	Abs.						4,634	
Whitton, E. A.											
Shreveport field, Caddo Parish	Shreveport	2.0	0.8	Abs.						1,800	
Total**		7,711.3	6,011.5		830,360	177,006	321,472	149,361	1,280,000	1,923,414	639,465

*Includes heavier ends. †Plant in process of expansion January 1, 1961. ‡As reported in 1960 survey. §All figures are capacity. [9]Unstabilized condensate separated at Dubach plant. ‖Two units. **Normal butane total includes butanes that are not split.

Michigan

Dow Chemical Co.											
Beaver Creek field, Crawford County	Grayling	12.0	5.0	Refr.				6,000			
Ohio Oil Co.											
Scipio field, Hillsdale County	Mosherville	25.0	16.3	Refr.-abs.	29,459				26,087		
Total		37.0	21.3		29,459			6,000	26,087		

Mississippi

California Co.											
Brookhaven field, Lincoln County	Brookhaven	45.0	40.0	Abs.	1,500			5,484		10,387	
★ Cranfield field, Adams County	Natchez	200.0	200.0	Abs.	12,155					27,880	
Shell Oil Co.											
Little Creek field, Pike County	Brookhaven	5.0	6.0	Refr.	5,500					12,000	
Sun Oil Co.											
McComb field, Pike County		10.0	4.3	Refr.-abs.	7,555		6,222			4,691	
Total		260.0	250.3		26,710		6,222	5,484		54,958	

Montana

Union Oil Co. of California											
Cut Bank field, Glacier County	Cut Bank	60.0	23.0	Abs.	6,200			7,800		6,500	
Union Texas Natural Gas Corp.											
Pine unit field, Wibaux County	Glendive	NR	6.0	Abs.					42,000		
Total		67.5	29.0		6,200			7,800	42,000	6,500	

Company, Plant, and Location	Nearest Town	M.M.c.f. daily Capacity	M.M.c.f. daily Through-put	Process Method	Production—Gallons Daily Propane	Isobutane	Normal Butane	LPG Mix	Combined Gaso.-LPG	Natural Gasoline	Other
Nebraska											
Antelope Gas Products Co.											
Kimball plant, various fields, Kimball County	Kimball	8.5	7.8	Abs.	26,000	.....	10,000	.....	.....	14,000	.....
Banner plant, various fields, Banner County	Kimball	9.0	7.6	Abs.	30,000	.....	10,000	.....	.....	16,000	.....
Kansas-Nebraska Natural Gas Co., Inc.											
Big Springs field, Deuel County	Ogallala	35.0	35.0	Refr.-abs.	12,000	.....	2,500	.....	.....	5,000	.....
Ohio Oil Co.											
Huntsman field, Cheyenne County	Sidney	12.5	10.0	Abs.	10,886	.....	9,253	.....	.....	8,063	.....
West Sidney field, Cheyenne County	Sidney	12.5	8.5	Refr.-abs.	12,552	.....	7,199	.....	.....	6,114	.....
Total		77.5	68.9		91,438	.....	38,952	.....	.....	49,177	.....
New Mexico											
Atlantic Refining Co.											
Denton field, Lea County	Lovington	29.4	16.8	Abs.	43,265	.....	33,753	.....	.....	24,806	.....
Cabot Corp.											
King field, Lea County	Lovington	6.0	3.0	Refr.	.....	.....	.....	.....	10,835	.....	.....
Continental Oil Co.											
El Mar field, Lea County	Jal	2.5	1.7	Refr.	2,218	.....	1,112	.....	.....	1,082	.....
Maljamar field, Lea County	Maljamar	16.0	15.8	Abs.	15,482	.....	6,697	.....	.....	10,659	.....
El Paso Natural Gas Co.											
Bagley field, Lea County	Tatum	10.0	7.0	Ads.	.....	.....	.....	.....	.....	1,428	.....
Blanco plant, San Juan County	Bloomfield	550.0	420.0	Abs.	.....	.....	.....	.....	*(383,300)	.....	.....
Chaco plant, San Juan County	Bloomfield	262.0	251.0	Abs.	.....	.....	.....	.....	*(314,800)	.....	.....
Jal No. 1 plant, Lea County		240.0	164.0	Abs.	.....	.....	.....	.....	†(44,300)	.....	.....
Jal No. 2 plant, Lea County		130.0	82.0	Abs.	.....	.....	.....	.....	†(93,800)	.....	.....
Jal No. 3 plant, Lea County		100.0	93.0	Abs.	.....	.....	.....	.....	†(84,300)	.....	.....
Jal No. 4-A plant, Lea County		185.0	191.0	Abs.	.....	.....	.....	.....	†(117,700)	.....	.....
Jal No. 4-B plant, Lea County (fractionator for other Jal plants)		.....	.....	.....	85,600	.....	116,600	.....	.....	140,200	.....
San Juan River plant, San Juan County	Farmington	70.0	72.0	Abs.	10,400	.....	15,300	.....	.....	15,700	.....
Santa Rosa plant, Guadalupe County		30.0	30.7	Abs.	13,300	.....	8,300	.....	.....	10,200	.....
Wingate plant, McKinley County (fractionation plant for plants at Aneth, Utah, and Blanco and Chaco, N. M.)	Gallup	.....	.....	.....	327,500	20,800	434,400	.....	.....	227,500	.....
Frontier Natural Gasoline Co.											
Grayburg-Jackson field, Eddy County	Loco Hills	7.0	5.5	Abs.	10,000	.....	5,000	.....	.....	5,000	.....
Horshoe Gallup Gasoline Corp.											
San Juan County‡	Farmington	4.0	.....	Abs.	.....	.....	.....	.....	.....	.....	.....
Northern Natural Gas Co. (formerly Permian Basin Pipeline Co.), Lea County	Hobbs	200.0	140.0	Abs.	31,000	.....	34,000	.....	.....	45,000	.....
Pan American Petroleum Corp.											
Empire Abo plant, Eddy County	Artesia	20.0	9.0	Refr.	6,900	.....	6,900	.....	.....	6,300	.....
Empire Abo plant, Eddy County	Artesia	10.0	7.2	Ads.	.....	.....	.....	.....	1,250	.....	.....
Phillips Petroleum Co.§											
Artesia plant, various fields, Eddy County	Artesia	35.0	NR	Abs.	.....	.....	.....	.....	100,000	.....	.....
Eunice field, Lea County	Oil Center	115.0	NR	Abs.	.....	.....	.....	.....	200,000	.....	.....
Hobbs field, Lea County	Hobbs	25.0	NR	Abs.	.....	.....	.....	65,000	.....	50,000	.....
Lee field, Lea County	Hobbs	65.0	NR	Abs.	.....	.....	.....	.....	185,000	.....	.....
Sinclair Oil & Gas Co.											
Tatum (No. 29) plant, Gladiola field, Lea County	Tatum	22.0	18.0	Refr.-abs.	25,000	.....	.....	15,000	.....	22,000	.....
Skelly Oil Co.											
Eunice No. 1 & 2 plants, various fields, Lea County	Eunice	130.0	NR	Abs.	81,000	14,000	34,000	.....	.....	84,000	.....
Lovington field, Lea County	Lovington	12.0	NR	Abs.	17,000	.....	.....	18,000	.....	.....	.....
Maljamar plant, Loco Hills field, Eddy County	Loco Hills	15.0	NR	Refr.-abs.	18,000	.....	.....	20,000	.....	.....	.....
Southern Union Gas Co.											
Kutz plant, San Juan County	Bloomfield	55.0	38.2	Abs.	8,900	.....	11,750	.....	.....	10,330	.....
Lybrook plant, Rio Arriba County	Lybrook	65.0	34.8	Refr.-abs.	26,400	.....	17,220	.....	.....	9,140	.....

Company, Plant, and Location (★ indicates cycling)	Nearest Town	M.M.c.f. daily Capacity	M.M.c.f. daily Throughput	Process Method	Production—Gallons Daily Propane	Isobutane	Normal Butane	LPG Mix	Combined Gaso.-LPG	Natural Gasoline	Other
NEW MEXICO (Continued)											
U. S. Bureau of Mines											
Shiprock helium plant	(Operations resumed in 1959 at helium output of 3.5 M.M.c.f. daily)										
Valley Gas Co.											
Anderson field, Lea County	Lovington	5.0	3.5	Refr.	12,000		5,000			6,000	
Loco Hills field, Eddy County	Artesia	6.0	4.0	Refr.	8,000		3,000			3,000	
Warren Petroleum Corp.											
Eunice plant, Lea County		NR	56.0	Abs.	58,081			38,935		32,671	
Monument plant, Lea County		NR	85.0	Abs.	41,586			45,681		43,011	
Saunders plant, Lea County		NR	35.0	Abs.	62,606			38,376		30,937	
Total¶		2,641.9	2,102.2		904,238	34,800	741,032	240,992	497,085	778,964	

*Products separated at Wingate plant. †Products separated at Jal No. 4-B plant. ‡Formerly Turner & West's Peter's plant, moved from Young County, Texas. Reconstruction completed December 1960. §All figures are capacity. Products of all four plants further processed at Borger, Tex., fractionator. Products from Eunice further processed at Hobbs as well as Borger. ¶Normal butane total includes butanes that are not split.

North Dakota

Signal Oil & Gas Co.											
Tioga-Beaver Lodge field, Williams County	Tioga	65.0	48.7	Abs.	84,000		50,000			30,000	

Oklahoma

Apache Gas Products Corp.											
Kendrick field, Lincoln County (formerly owned by Moran Gasoline Corp.)	Kendrick	18.0	18.0	Abs.	11,000		3,500			11,000	
Apache Gasoline Co.											
Ardmore plant, West Brock field, Carter County	Lone Grove	4.0	2.0	Abs.				4,620	6,980	2,360	
Boswell-Frates Co.											
Edna field, Creek County	Bristow	(Dismantled)									
Norfolk field, Payne County	Cushing	(Sold to Gas Products Corp.)									
British-American Oil Producing Co.											
Knox field, Grady County	Marlow	50.0	30.0	Refr.	12,000					*175,000	
Champlin Oil & Refining Co.											
Witcher field, Oklahoma County	Oklahoma City	30.0	15.0	Refr.-abs.	12,000		4,000			13,600	
Chapman Gasoline Plant	Holdenville	6.0	3.0	Abs.	(Liquids not reported)						
Cities Service Petroleum Co.											
Ambrose plant (transmission line), Kay County	Blackwell	290.0	253.0	Refr.-abs.	130,000	24,000	60,000			65,000	
Bodine plant, Oklahoma City field, Oklahoma County	Okla. City	7.0	5.0	Abs.	3,800		3,600			4,600	
Guymon plant, Hugoton field, Texas County	Guymon	(Drip control plant)									
Continental Oil Co.											
Short Junction field, Cleveland County	Okla. City	60.0	29.8	Refr.-abs.	20,224		9,985			13,856	
Dorchester Corp.											
Panoma plant, Guymon-Hugoton field, Texas County	Hooker	130.0	71.1	Abs.	21,272	7,435	18,870			*17,170	
Eason Oil Co.											
★ Crescent, Columbia, and Lovell fields, Logan County	Crescent	13.0	9.2	Abs.	9,128			5,943		8,874	
El Paso Natural Gas Co.											
Beaver City plant, Beaver County	Beaver City	12.0	12.0	Ads.						1,806	
Ells, Harry, Inc.											
Shell Barco plant, Healdton field, Carter County	Healdton	2.5	1.8	Abs.	3,000				7,000		
Excelsior Oil Corp. (subsidiary of Kansas-Nebraska Natural Gas Co. Inc.)											
Tyrone plant, Guymon-Hugoton field, Texas County	Tyrone	45.0	47.0	Refr.-abs.	9,000		11,000			10,000	
Frame Natural Gasoline Co.											
Pawnee County	Cleveland	NR	5.0							1,300	
Gas Products Corp. (plant formerly owned by Boswell-Frates)											
Norfolk field, Payne County	Cushing	1.0	0.5	Comp.						200	

Company, Plant, and Location (★ indicates cycling)	Nearest Town	M.M.c.f. daily Capacity	M.M.c.f. daily Throughput	Process Method	Production—Gallons Daily Propane	Isobutane	Normal Butane	LPG Mix	Combined Gaso.-LPG	Natural Gasoline	Other
OKLAHOMA (Continued)											
Gasoline Plant Management Co.											
Lucien unit plant, Noble County	Perry	8.0	5.5	Abs.	10,000		6,000			7,000	
Grimes, Otha H., and others											
Pauls Valley field, Garvin County	Pauls Valley	5.0	2.5	Abs.				5,225	7,330	2,105	
Grimes & Grimes											
Okemah field, Okfuskee County	Okemah	1.0	0.5	Abs.					420	420	
Weleetka (pipeline), Okfuskee County	Weleetka	15.0	14.0	Abs.				1,975	4,595	2,620	
Grimes Gasoline Co.											
Wetumka plant, Hughes County	Wetumka	(Shut down)									
Highway Gasoline Co.											
Middle and West Peck fields, Lincoln County	Stroud	5.0	4.0	Abs.				5,905	7,880	1,975	
Hugoton Plains Gas & Oil Co.											
Hugoton field, Texas County	Tyrone	120.0	48.5	Refr.-abs.	20,219	4,148	9,076			8,763	
Humble Oil & Refining Co., Carter Division											
Fitts field, Pontotoc County	Ada	9.0	3.5	Refr.-abs.	9,200		3,100			7,300	
Keener Oil Co.											
★ Bartlett plant, Custer County	Butler	35.0	20.0	Refr.-abs.	12,000			11,000		500	
Kerr-McGee Oil Industries, Inc.											
Fitts field, Pontotoc County	Ada	(Permanently shut down July 31, 1960)									
Happy Valley plant, Lincoln County	Cushing	NR	3.5	Abs.	1,735		2,110			3,985	
Laffoon plant, Okfuskee County	Prague	NR	6.0	Abs.	6,515		3,505			4,070	
Stroud plant, Creek County	Stroud	NR	10.0	Abs.	7,225		3,605			6,580	
Lone Star Gas Co.											
Katie plant, Garvin County	Elmore City	40.0	29.0	Abs.					31,206		
Mobil Oil Co.											
★ Chitwood field, Grady County	Chickasha	24.6	14.1	Abs.	9,000					23,000	
Graham plant, Fox-Graham field, Carter County	Healdton	18.0	15.0	Abs.						37,000	
Sholem-Alechem field, Stephens County	Duncan	40.0	19.0	Abs.	29,000		7,800			22,000	
Northern Natural Gas Co.											
Beaver County		50.0		Abs.					†10,000		
Oil Recovery Corp. and Wellsville Oil Co.											
Bartlesville-Dewey field, Washington County	Dewey	0.6	0.6	Abs. & Comp.	(30 tons per day of CO_2 gas.)						
Oklahoma Gas Hydrocarbon Corp.											
Marlow field (transmission line), Stephens County	Marlow	25.0	18.0	NR				7,000	12,000	6,000	
Patton & Swab, Inc.											
Edmond field, Oklahoma County	Edmond	20.0	10.0	Abs.					10,000		
Phillips Petroleum Co.‡											
Bradley field, Garvin County§	Lindsay	140.0	NR	Abs.					250,000		
DeNoya plant, Burbank field, Osage County	Shidler	15.0	NR	Abs.	15,000		10,000			20,000	
Edmond field, Oklahoma County§	Edmond	80.0	NR	Abs.					190,000		
Oklahoma City field, Oklahoma County§	Okla. City	16.0	NR	Abs.					65,000		
Oklahoma City fractionator	(Processes products from Bradley, Edmond, and Oklahoma City plants.)										
Reserve plant, Burbank field, Osage County	Fairfax	8.0	NR	Abs.					35,000		
Wewoka field, Seminole County	Wewoka	6.0	NR	Abs.				10,000		6,000	
Pure Oil Co.											
Glen Pool plant, Sapulpa field, Creek County (shut down November 1, 1960)	Sapulpa	4.0	3.5	Comp. & Abs.						4,500	
Redco Corp.											
Grisso plant, Seminole field, Hughes County	Okfuskee	20.0	15.0	Abs.	30,000		20,000			30,000	
Service Gas Products Co.											
Plant No. 1, Aylesworth field, Marshall County	Madill	2.8	0.8	Abs.				816		1,718	
Plant No. 2, Doyle field, Stephens County	Marlow	22.5	18.4	Abs.				21,313		16,628	
Plant No. 3, West Hoover field, Garvin County	Davis	10.0	9.7	Abs.				7,505		9,306	
Shell Oil Co.											
Dillard plant, Hewitt field, Carter County	Wilson	8.0	6.0	Abs.	4,000					26,000	

Company, Plant, and Location (★ indicates cycling)	Nearest Town	M.M.c.f. daily Capacity	M.M.c.f. daily Through-put	Process Method	Production—Gallons Daily Propane	Isobutane	Normal Butane	LPG Mix	Combined Gaso.-LPG	Natural Gasoline	Other
OKLAHOMA (Continued)											
★ Elk City-Hoxbar unit, Beckham County	Elk City	250.0	246.0	Abs.	100,000	.....	.....	.....	.....	154,000	.....
Signal Oil & Gas Co.											
Fox-Milroy field, Carter County	Healdton	70.0	63.0	Refr.-abs.	70,000	13,000	26,000	2,700	.....	50,000	.....
Sinclair Oil & Gas Co.											
Covington (No. 6) plant, Garber field, Garfield County	Covington	50.0	21.0	Abs.	22,000	5,000	12,000	.....	.....	23,000	.....
Drumright (No. 2) plant, Cushing field, Creek County	Drumright	14.0	11.0	Abs.	25,000	.....	2,000	.....	.....	51,000	.....
Seminole (No. 13) plant, Seminole County	Seminole	15.0	12.0	Abs.	35,000	5,000	10,000	.....	.....	37,000	.....
St. Louis (No. 14) plant, Pottawatomie County	St. Louis	14.0	9.0	Abs.	31,000	.....	5,000	.....	.....	33,000	.....
Skelly Oil Co.											
Velma field, Stephens County	Velma	70.0	NR	Abs.	41,000	9,000	17,000	.....	.....	38,000	.....
Sohio Petroleum Co.											
Elmore plant, Eola field, Garvin County	Elmore	35.0	31.0	Refr.-abs.	35,000	.....	20,000	.....	.....	20,000	.....
Trindle plant, West Edmond field, Kingfisher County	Edmond	10.0	6.0	Abs.	.....	.....	.....	3,000	.....	4,000	.....
Sterling Gasoline Plant of Garber, Inc.											
Spring Valley field, Garfield County	Garber	(Dismantled)									
Sun Oil Co.											
Laverne field, Harper County		100.0	93.5	Refr.-abs.	57,175	9,665	22,540	.....	.....	22,682	.....
Sunray Mid-Continent Oil Co.											
Carney plant, various fields, Lincoln County	Chandler	30.0	12.0	Refr.-abs.	8,500	.....	5,000	.....	.....	3,500	.....
Criner plant, various fields, McClain County	Purcell	30.0	26.0	Refr.-abs.	45,000	.....	25,000	.....	.....	14,000	.....
Moore field, Cleveland County	Moore	32.0	22.0	Refr.-abs.	21,000	.....	14,000	.....	.....	12,000	.....
Texaco Inc.‡											
Camrick plant, Beaver County	Gray	50.0	NR	Abs.	24,000	.....	23,500	.....	.....	27,500	.....
Davenport plant, Lincoln County	Davenport	15.0	NR	Abs.	20,000	.....	10,000	.....	.....	14,700	.....
U. S. Bureau of Mines											
Keyes helium plant, Cimarron County	Keyes	70.0	(One of five government-operated helium plants in U. S.)								
Warren Petroleum Corp.											
Kiefer plant, Creek County		NR	11.0	Abs.	.....	.....	.....	1,682	.....	21,384	.....
Madill plant, Marshall County		NR	15.0	Abs.	13,293	.....	.....	2,796	.....	18,401	.....
Marlow field, Grady County		(Dismantled)									
Maud field, Pottawatomie County		(Sold to Sinclair and being dismantled.)									
Maysville plant, Garvin County		NR	344.0	Abs.	335,601	.....	.....	136,936	.....	195,796	.....
Mocane plant, Beaver County		NR	115.0	Refr.-abs.	44,242	.....	.....	35,260	.....	36,439	.....
Ringwood plant, Major County		NR	28.0	Abs.	16,651	.....	.....	13,127	.....	16,290	.....
Wunderlich Development Co.											
Kay County	Newkirk	12.0	7.0	Refr.	12,713	.....	5,448	.....	.....	8,296	.....
Total¶		2,955.0	2,228.0		1,342,493	77,248	373,639	276,803	637,411	1,381,824	.....

*Includes heavier ends. †Product estimation for new plant completed November 1960. ‡All figures are capacity. §Products further processed at Oklahoma City fractionator. ¶Normal butane total includes butanes that are not split.

Pennsylvania

Mars Co.											
Lamont plant, Kane field, Elk County	Kane	4.0	3.0	Abs.	.....	.....	.....	.....	.....	800	.....
Van plant, Strong field, Venango County	Oil City	4.0	1.5	Abs.	4,000	.....	2,000	.....	.....	1,900	.....
Pennsylvania Gas Co.											
Roystone station, Warren County	Sheffield	11.0	10.0	Abs.	.....	.....	.....	.....	.....	800	.....
Peoples Natural Gas Co.											
Greene field, Greene County	Waynesburg	5.0	3.8	Ads.	.....	.....	.....	.....	.....	1,119	.....
Total		24.0	18.3		4,000	.....	2,000	.....	.....	4,619	.....

Company, Plant, and Location (★ indicates cycling)	Nearest Town	M.M.c.f. daily Capacity	M.M.c.f. daily Through-put	Process Method	Production—Gallons Daily Propane	Isobutane	Normal Butane	LPG Mix	Combined Gaso.-LPG	Natural Gasoline	Other
Texas											
Amarillo Oil Co.				Abs.							
Fain plant, West Panhandle field, Potter County	Amarillo	100.0	42.0		2,760		6,920			7,580	
Pampa plant, East Panhandle field, Gray County (Figures estimated for new plant)	Pampa	60.0	40.0	Refr.-abs.	20,000				25,000		
Turkey Creek plant, West Panhandle field, Potter County	Amarillo	100.0	24.3	Abs.	3,170		10,400			8,330	
Amerada Petroleum Corp.											
Adair field, Terry County	Brownfield	1.5	1.1	Refr.				8,933		1,952	
Anchor Gasoline Corp.											
Tabasco field, Hidalgo County	Mission	57.0	NR	Abs.					39,000		
Argo Oil Corp.											
Roos Wilcox field, McMullen County	George West	35.0	18.8	Ads.					5,722		
Arkansas Fuel Oil Corp.	(See Cities Service for former Arkansas Fuel plants.)										
Arkansas Louisiana Chemical Corp.											
Carthage field, Panola County	Carthage	40.0	22.0	Abs.				9,800		*15,200	
Jefferson field, Marion County	Jefferson	31.0	10.0	Abs.				4,300		*6,000	
North Lansing field, Harrison County	Hallsville	30.0	25.0	Ads.					7,500		
Waskom plant, various fields, Harrison County	Waskom	205.0	152.0	Refr.-abs.	22,500	16,000	24,500			*97,000	[5]5,800 [6]3,200 †1,900
Atlantic Refining Co.											
Block 31 field, Crane County	Crane	68.0	68.0	Abs.	54,564		34,307		16,957	19,941	
East Corpus Christi Bay field, Nueces County	Corpus Christi	13.0	15.0	Ads.						10,700	
East Rhode Ranch field, McMullen County	George West	12.0	11.0	Ads.						1,800	
Barnhart Hydrocarbon Corp.											
Barnhart field, Reagan County	Big Lake	25.0	15.0	Abs.	20,000		9,000			15,000	
Black Hawk Gasoline Corp.											
Jack County	Graham	3.0	1.5	Comp.					14,000		
Bowie Gasoline Co.											
Montague and other fields, Montague County	Bowie	20.0	4.5	Abs.	13,250			7,500		6,200	
Brazos River Gas Co.											
Various fields, Palo Pinto County	Mineral Wells	26.0	17.5	Refr.-abs.	11,250			9,000		6,750	
Breckenridge Gasoline Co.											
Eliasville plant, Stephens County	Eliasville	10.0	5.0	Abs.				8,000		8,000	
Lodi plant, Cass County	Bivins	30.0	21.5	Abs.				20,000		20,000	
Cabot Corp.											
Estes plant, South Kermit field, Ward County	Monahans	30.0	24.0	Abs.	3,278	2,950	5,605			23,437	
Walton plant, Kermit area, Winkler County	Kermit	30.0	30.0	Abs.	12,025	4,431	12,020			18,779	
Carthage Company											
Carthage field, Panola County	Carthage	475.0	260.0	Abs.	75,000		95,000			200,000	[4]42,500 [8-9]7,500
Caska Corp.											
Wood County	Quitman	20.0	NR	Abs.	2,693		11,468			10,302	
Champlin Oil & Refining Co.											
Carthage field, Panola County	Carthage	210.0	220.0	Refr.-abs.	35,000	22,000	32,200			122,000	[9]3,200
★Coastal plant, Stratton field, Nueces County	Agua Dulce	120.0	55.0	Abs.	11,000	5,500	5,500			32,000	[1]20,600 [9]3,700
★Gulf Plains plant, Stratton field, Nueces County	Bishop	220.0	210.0	Refr.-abs.	75,000	24,800	20,800			101,000	[1]76,000 [5]5,900
Chillgas Corp.											
Wellman field, Terry County	Brownfield	2.0	1.0	Refr.				7,000		1,300	
Cities Service Petroleum Co.											
Chico-East Chico field, Wise County	Chico	65.0	55.0	Refr.-abs.	55,000		39,000			31,000	
East Texas field, Gregg County	Longview	50.0	21.6	Refr.-abs.	30,000		19,000			*16,800	
Lehman plant, West Levelland and Buckshot fields, Cochran County	Lehman	25.0	20.0	Abs.	9,000		13,000			13,000	
May field, Kleberg County	Riveria	50.0	39.0	Refr.-abs.	14,000		10,000			9,000	
Pampa field, Gray County	Pampa	50.0	46.0	Abs.	41,000		38,000			47,000	

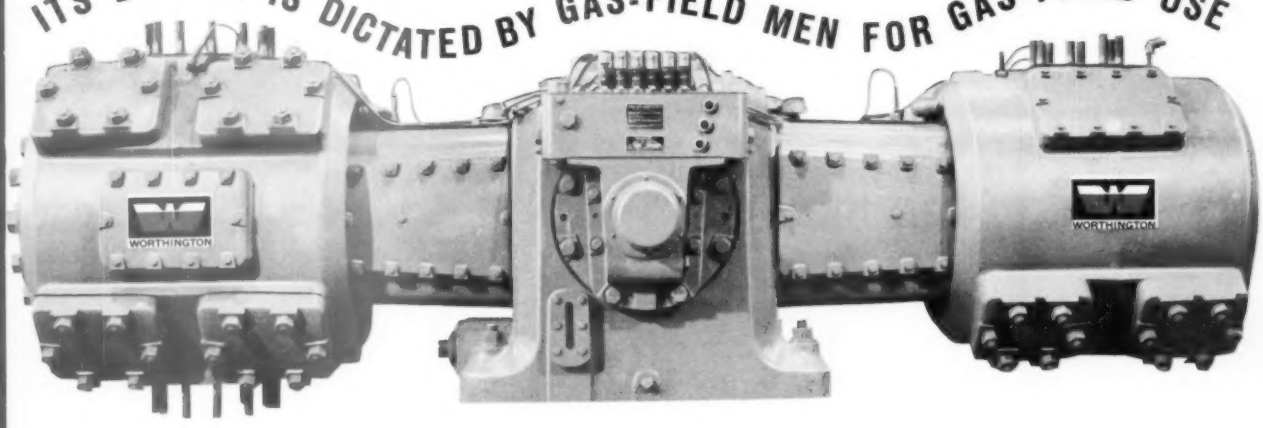
Company, Plant, and Location (★ indicates cycling)	Nearest Town	M.M.c.f. daily Capacity	M.M.c.f. daily Through-put	Process Method	Production—Gallons Daily Propane	Isobutane	Normal Butane	LPG Mix	Combined Gaso.-LPG	Natural Gasoline	Other
TEXAS (Continued)											
Panola plant, Carthage field, Panola County	Carthage	100.0	68.3	Refr.-abs.	22,000	10,000	11,000				[3]2,300 [5]75,000 [9]2,700 [11]2,700
Stonewall plant, various fields, Stonewall County‡	Knox City	18.0	16.0	Refr.-abs.	46,000		31,000			25,000	
West Seminole field, Gaines County	Seminole	15.0	10.0	Abs.	12,000		16,000			12,000	
Cities Service Production Co.											
Roberts Ranch field, Midland County	Odessa	35.0	18.0	Refr.-abs.					60,000		
Clark Fuel Producing Co.											
Sullivan City field, Hidalgo County	Sullivan City	20.0	11.8	Ads.						1,265	
Coates, George H.											
Jay Simmons field, Starr County	Rio Grande City	5.0	2.0	Refr.						[8]3,500	
Rico field, Hidalgo County	La Reforma	7.0	3.0	Refr.						[8]3,800	
Colorado Interstate Gas Co.											
Bivins plant, Panhandle field, Moore County	Dumas	165.0	76.0	Abs.					20,990		
Fourway plant, Panhandle field, Moore County	Dumas	150.0	90.0	Abs.					62,070		
Coltexo Corp.											
Lefors No. 78-1 plant, Panhandle field, Gray County	Lefors	50.0	34.0	Refr.-abs.					94,445		
Columbian Carbon Co.											
Seminole field, Gaines County	Seminole	30.0	20.0	(Desulfurization plant.)							
Continental Oil Co.											
KMA field, Wichita County	Electra	11.2	5.4	Refr.					49,833		
Ramsey field	Orla	5.0	3.7	Refr.	4,735		895			8,293	
Rincon field, Starr County	Rio Grande City	21.5	17.8	Refr.-abs.				8,724		19,330	
Todd Ranch field, Crockett County	Big Lake	9.3	2.7	Abs.	1,740		3,839			2,664	
Delhi-Taylor Oil Corp.											
★ McAllen and Pharr fields, Hidalgo County	McAllen	165.0	88.4	Refr.-abs.	6,250	9,950		15,500		*40,200	
Distillate Production Corp.											
★ North Houston field, Harris County	Houston	75.0	45.0	Abs.	15,000	5,000	5,500			15,000	[8-9]500
Dorchester Corp.											
Cargray plant, Panhandle field, Carson County	White Deer	110.0	61.0	Abs.	28,293	9,084	23,820			*7,180	[3]5,430 [4]5,850 [5]27,320
Texon plant, Big Lake field, Reagan County	Texon	5.5	4.5	Refr.					12,016		
El Paso Natural Gas Co.											
Brown-Bassett field, Terrell County	(New solvent CO_2 removal plant.)										
Jack Herbert field, Upton County	Crane	10.0	7.0	Ads.						1,512	
Midkiff plant, Reagan County	Midland	166.0	141.0	Abs.	212,800		114,200			109,400	
Sealy Smith plant, Ward County	Monahans	16.5	13.1	Abs.	6,000		9,000			8,400	
Westlake plant, Nolan County	Sweetwater	25.0	22.2	Abs.					83,000		
Etexas Producers Gas Co.											
Chapel Hill field, Smith County	Tyler	15.0	11.0	Abs.				5,500		10,000	
Francitas Gas Co.											
★ Francitas field, Jackson County	Blessing	40.0	22.0	Abs.				4,500			[5]12,000 [6]600 [9]900
Gasoline Production Division, H. B. Zachry Co.											
★ Tuleta plant, Ray-Wilcox field, Bee County	Mineral	40.0	20.0	Abs.				4,000			[5]8,000 [6]900 [9]650
Gillring Oil Co.											
Agua Dulce field, Nueces County	Banquette	50.0	26.0	NR				9,000		7,000	
Goliad Corp.											
Clayton plant, Live Oak County	George West	55.0		Abs.	(See Hagist plant for liquids.)						
Hagist central fractionator, Duval County	Freer	70.0	173.0	Abs.	53,456	30,586	38,928		120,078		[11]39,600
Kittie plant (Karon remote absorber), Live Oak County	Three Rivers	80.0		Abs.	(See Hagist plant for liquids.)						
Wilcox plant, Lavaca County	Halletsville	250.0	237.0	Refr.-abs.	74,754		65,835			*62,414	
Graridge Corp.											
Eastland field, Eastland County	Eastland	18.0	7.0	Refr.-abs.	4,000			8,000		4,000	
Ibex field, Shackelford County	Albany	10.0	5.0	Abs.				3,000		3,000	

Company, Plant, and Location (★ indicates cycling)	Nearest Town	M.M.c.f. daily Capacity	M.M.c.f. daily Through-put	Process Method	Production—Gallons Daily Propane	Isobutane	Normal Butane	LPG Mix	Combined Gaso.-LPG	Natural Gasoline	Other
TEXAS (Continued)											
South Bend field, Young County	Graham	8.0	8.0	Abs.	7,000		7,000			6,000	
Grimes, Otha H.											
North Dora field, Nolan County	Sweetwater	4.5	3.0	Abs.				9,495	22,405	12,910	
Ringgold field, Clay County	Ringgold	3.0	1.5	Abs.				3,080	4,200	1,120	
Henderson, Frank C., Trust No. 2											
Sanford plant, West Panhandle field, Hutchinson County	Borger	50.0	30.0	Abs.						30,000	
Honolulu Oil Corp.											
Prentice field, Yoakum County	Tokio	14.0	9.7	Comp. & Abs.					41,374		
Ropes field, Hockley County	Snyder	2.0	0.8	Comp. & Refr.	2,208			3,341		1,942	
White Flat field, Nolan County	Trent	6.5	3.8	Comp. & Refr.	6,781			14,127		6,712	
Houston Hydrocarbon Corp.											
Cardona Lake field, Crane County	Crane	5.0	2.0	Abs.					6,000		
Howsley, A. M.											
Sappington plant, Glen Cove (Jennings) field, Coleman County	Glen Cove	1.8	1.5	NR				1,353		1,654	
Huber Corp., J. M.											
Borger plant, Panhandle field, Hutchinson County	Borger	65.0	58.0	Refr.-abs.						36,000	
Humble Oil & Refining Co., Humble Division											
Anahuac plant, Chambers County	Monroe City	100.0	81.0	Abs.					36,768		
Clear Lake plant, Harris County	Genoa	200.0	167.9	Abs.	16,163				68,540		
Conroe plant, Montgomery County	Conroe	33.0	29.6	Abs.	12,537				28,628		
East Texas plant, Rusk County	Overton	105.0	58.0	Abs.	47,227	9,829	23,077			32,555	
Flour Bluff plant, Nueces County	Corpus Christi	35.0	24.9	Abs.				12,383		9,048	
Heyser plant, Calhoun County	Bloomington	18.0	10.4	Abs.						3,707	
Jourdanton plant, Atascosa County	Jourdanton	26.0	15.2	Abs.	4,443			7,871		10,453	
★ Julian plant, Kenedy County	Encino	9.0	8.2	Refr.						*41,212	
★ Katy plant, Waller County	Katy	555.0	510.1	Abs.		72,805	46,180			*430,302	[2]407,402
★ King Ranch plant, Kleberg County§	Kingsville	800.0	643.5	Abs.	243,600	84,000	96,600			*453,600	[1]243,600
Neches plant, Cherokee County	Jacksonville	9.5	4.8	Abs.					25,131		
Pickton plant, Hopkins County	Pickton	54.0	49.4	Abs.	13,111		14,188	4,791		24,508	
Pledger plant, Brazoria County	Danciger	190.0	173.0	Abs.		13,190		72,560		*80,445	[9]5,501
Tomball plant, Harris County	Tomball	57.0	47.1	Abs.					31,990		
Tom O'Connor plant, Refugio County	Refugio	160.0	134.4	Abs.	8,760	5,022				32,028	
Hunt Oil Co.											
Alta Loma field, Galveston County	Alta Loma	22.0	26.0	Refr.-abs.					26,800		
Wilshire field, Upton County	Crane	16.0	13.0	Abs.					47,800		
Kerr-McGee Oil Industries, Inc.											
Cactus plant, Moore County	Etter	NR	54.0	Abs.					55,275		
Pampa plant, Gray County	Pampa	NR	25.0	Abs.	16,330		13,930			31,340	
La Gloria Oil & Gas Co.											
★ La Gloria field, Jim Wells County	Falfurrias	330.0	284.0	Abs.	61,000	25,500	25,200			100,000	[1]94,000 [8]1,000 [9]16,400
Lion Oil Co.											
Diamond "M"-Sharon Ridge plant, Scurry County	Snyder	55.0	22.0	Abs.	111,065	56,848				43,368	
Manor Lake field, Brazoria County	West Columbia	25.0	18.0	Ads.						1,680	
Lone Star Gas Co.											
Gordon plant, Palo Pinto County	Gordon	75.0	36.0	Abs.	24,227				[4](26,157)		
Madisonville plant, Madison County	Madisonville	25.0	20.0	Ads.						2,900	
Pueblo plant, Eastland County	Cisco	40.0	13.0	Abs.					[4](11,928)		
Springtown plant, Parker County	Springtown	250.0	103.0	Abs.	30,244	6,190	25,236			33,186	[3]3,705
Trinidad plant, Henderson County	Trinidad	240.0	94.0	Abs.	5,329	3,762	7,735			12,496	[3]2,684
Lone Star Producing Co.											
Brooks plant, Stephens County	Breckenridge	110.0	5.0	Abs.					[4](17,412)		
Carthage plant, Panola County	(Sold to Roger Lacy, Inc., in 1960.)										
★ Chapel Hill plant, Smith County	Tyler	45.0	38.0	Abs.	8,037					*18,696	
Fashing acid gas removal plant, Atascosa County	Karnes City	110.0	46.0							*37,319	

WORTHINGTON

NOW... THE ALL NEW CUB GAS-FIELD COMPRESSOR

ITS DESIGN IS DICTATED BY GAS-FIELD MEN FOR GAS-FIELD USE



THIS IS THE STORY...

6

GAS-FIELD FEATURES OF THE ALL-NEW WORTHINGTON CUB COMPRESSOR

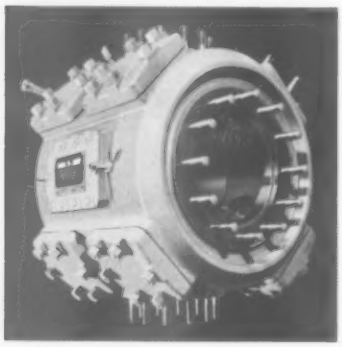
WORTHINGTON

1.

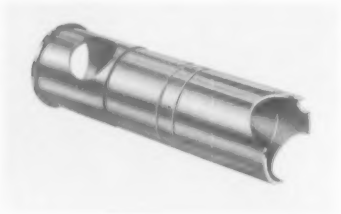
FLEXIBLE CAPACITY WITH EASY CHANGES

The CUB fully recognizes that gas-field pressure differentials vary widely. The cylinders have been designed for a very wide range of capacities and pressures. And they are designed for extremely fast field changes with less down time and minimum expense.

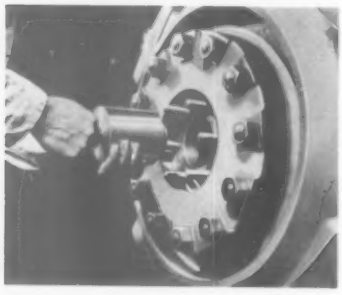
A simple cylinder change handles pressure variations all the way to 2000 psi.



Liners are easily inserted or removed to adjust capacity. This simple variation gives a broad range for any cylinder, with minimum conversion effort and expense.



Clearance plug, easily machined in the field, permits getting exact capacity required without extensive cylinder modification. It is extremely simple to change.

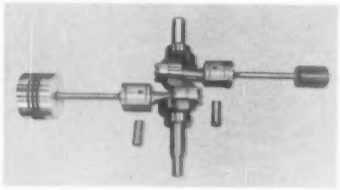


2.

DESIGN IS BETTER BALANCED, ELIMINATES VIBRATION

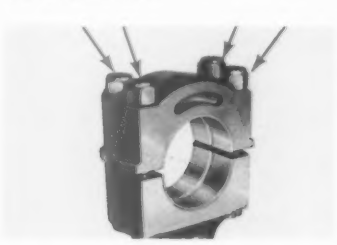
Vibration—the enemy of all compressors—is at an absolute minimum in the CUB. The balanced opposed principle inherently minimizes vibration to a level below that of other compressor designs.

The perfect balance of Worthington opposed compressors means there are no significant shaking forces. This means the supporting base needs to be only massive enough to support compressor weight. No excessive rigidity is required.



In the massive frame, heavy ribs fully absorb the crankshaft couple. And its extremely accurate machining maintains alignment.

Double protection is provided by the 4-bolt construction holding piston rod on to crankshaft.

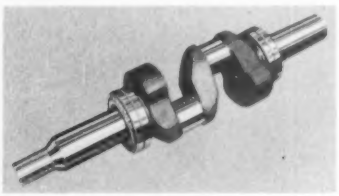


3.

MOST DEPENDABLE, FRICTION-FREE BEARING DESIGN

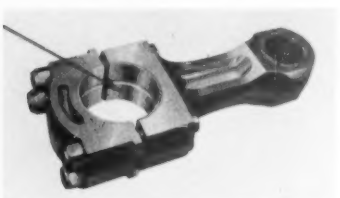
The use of friction-free main bearing design assures minimum friction losses in the CUB. Bearing sizes are conservative—selected for underloaded, longer life use.

Main crankshaft bearings are the more expensive, spherical-roller-bearing type. This reduces the overall length of the compressor. And the CUB runs with less friction, runs cooler, and maintains better full end-thrust control . . . with less sensitivity to lubrication troubles.



An easily renewable solid bronze bushing is used for the crosshead pin bearing for longest life. The wrist pin of specially hardened steel is super-finished to 5-7 micro inches and positively locked in place with snap rings.

The CUB connecting rod crankpin bearing is a high-speed steel-backed babbit lined type. It is diamond bored to a mirror finish and exact size to completely eliminate scraping and fitting.



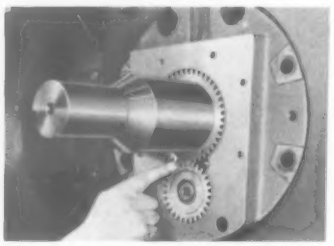
4.

FULL FORCE-FEED, COOLED AND FILTERED LUBRICATION

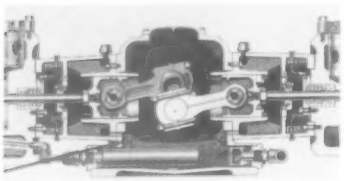
In any operation—but particularly unattended—dependability of lubrication is extremely important. With its full, force-feed, cooled and filtered lubrication system, the CUB will be as reliable as it is possible for any compressor to be.

Oil in the CUB is continuously filtered. A bypass filter in the oil pump housing keeps oil clean. The disc-type filter is readily removed for cleaning without disturbing piping.

All conn rod bearing surfaces are pressure lubricated. A positive gear pump—one gear integral with the crankshaft—force feeds all bearing surfaces through internal passages.



The CUB crankcase oil is water-cooled down to conservative operating temperatures. The oil cooler is completely enclosed in the frame and immersed in oil to prevent contamination.

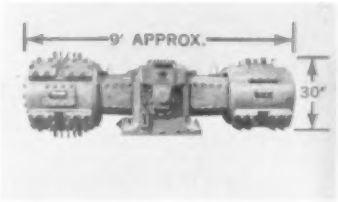


Cylinder lubrication is automatic also. Special lubricators provide six or more feeds to the cylinders and packing.

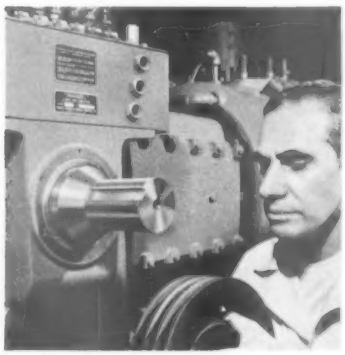
5.

MAJOR INSTALLATION ADVANTAGES

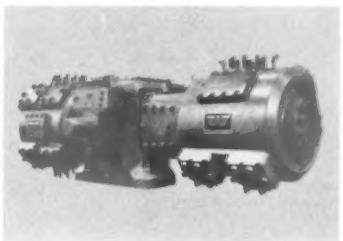
The CUB design results in a smaller skidded unit. Its overall width is up to a foot less than other units.



For user's convenience, the front end of the shaft is designed for power take-off to drive auxiliary equipment, such as fans or pumps.



Piping is at a minimum. There is only one water inlet and two water outlets. There are no external oil pipe connections.



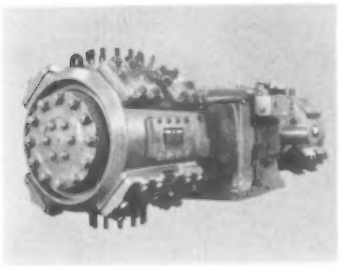
6.

MODERN APPEARANCE IS HIGHLY FUNCTIONAL

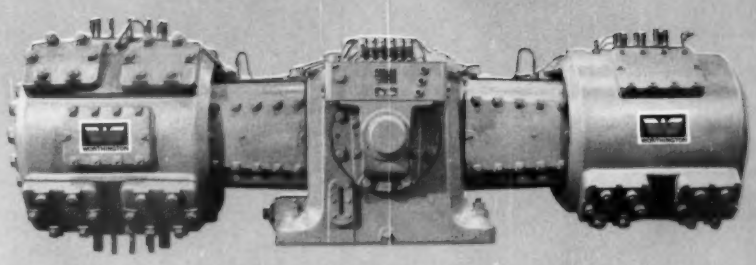
The Cub design was developed with the help of professional industrial stylists. It will give a modern, progressive feeling to any installation. But more important, the design is highly functional.

The CUB is extremely compact—engineered to produce maximum capacity with minimum horsepower requirements in the least space.

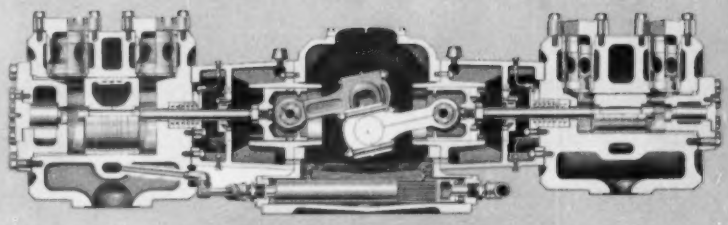
All oil piping on the CUB is internal. This prevents accidental breakage of external pipe lines. And it prevents dirt from entering oil system through disconnection of external lines.



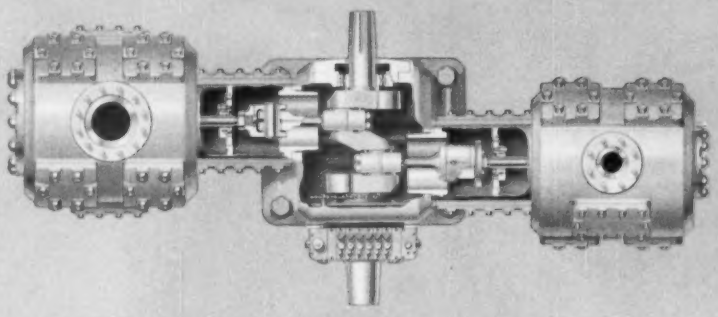
NOTE THE FUNCTIONAL DESIGN OF THE CUB



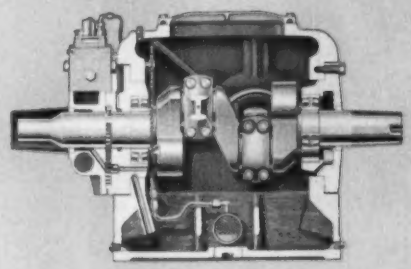
FRONT VIEW



FRONT VIEW



TOP VIEW



END VIEW

HOW GAS-FIELD MEN DICTATED CUB DESIGN

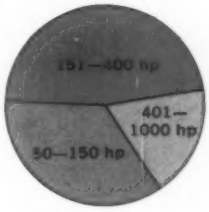
The new Worthington CUB compressor was literally born in gas fields . . . its design dictated by gas-handling men. A completely independent research organization traveled from Pennsylvania to California—from Texas to Canada. They gathered the opinions of compressor specialists, chief engineers and production superintendents. How large was the group contacted? These men had direct responsibility in fields totaling over 14,000 mmcf per day—better than one-third the national daily gas production.

What was the result? Opinions varied, of course. (They always do in the oil industry.) But out of their opinions a highly significant pattern emerged. And from it the CUB compressor was designed. Here is how the pattern developed:

PREFERRED HORSEPOWER RANGE

Size, based on horsepower, depends greatly on the installation. But nevertheless, in the range from 0 to 1000 horsepower, the 151-400 horsepower bracket shows demand for the greatest number of compressors. Or conversely—the 151-400 horsepower compressor is most useful.

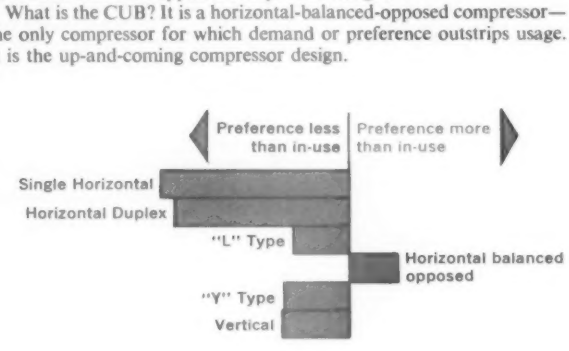
What is the CUB? It is designed for maximum pressures and capacities, according to gas-field needs, and operates within the most wanted horsepower range.



PREFERRED COMPRESSOR TYPE IN 151—400 HP RANGE

Each gas man surveyed had one or more compressor types in use in the 151-400 hp range. These types were tallied. Then the men were asked their preference. Did the preference follow usage? It did not! For all compressor types, preference rated below usage—except for the horizontal-balanced-opposed compressor design.

What is the CUB? It is a horizontal-balanced-opposed compressor—the only compressor for which demand or preference outstrips usage. It is the up-and-coming compressor design.



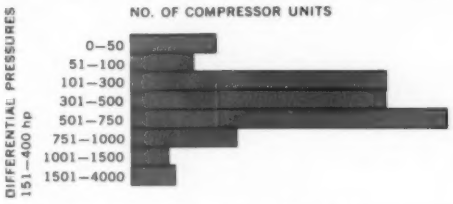
PREFERRED NO. OF CYLINDERS

Obviously, the number of cylinders will frequently conform to installation requirements. But nevertheless, a distinct preference was exhibited in weighing 2 versus 4 cylinder design where both apply . . . in favor of the 2 cylinder design as the chart shows.

What is the CUB? The CUB is two cylinders for the very reasons given by the experts in favoring 2 cylinder design. Less parts, more compact . . . and easier, faster maintenance.

MOST USEFUL OPERATIONAL RANGE

A major criticism of compressors was lack of flexibility. This is the ability of the compressor to be adapted to a variety of operating conditions, such as a wide range of gas pressure differentials in the same field. The table shows a summary of how the number of compressors varied with differential pressures for over 600 installations.



How does the CUB match up? A minimum number of cylinders, each with liner changes and a simple clearance plug change, lets the CUB match virtually *every* common installation pressure requirement up through 2000 psi.

PREFERRED DRIVER CONNECTION

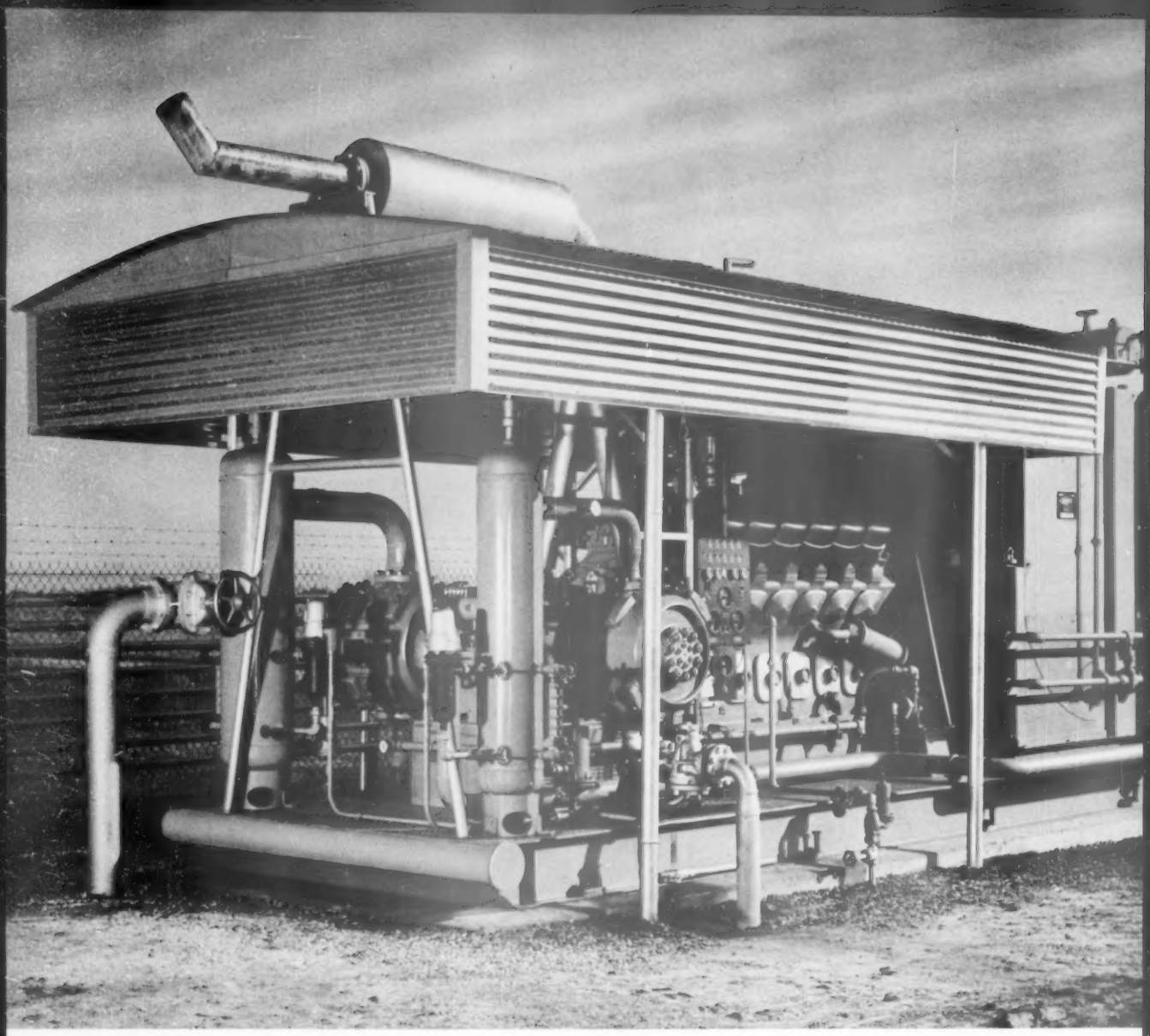
Experts had a distinct preference in drivers, too. They preferred Direct Drive over Belt and Gear Drives in the ratios shown. As a result, the CUB is designed for direct drive.

Why is Direct Drive preferred? Reasons like this were given: lower maintenance; less wear; more reliability; no belt trouble; easier alignment; no belt expense; more efficiency; less power loss; fewer moving parts; less vibration; better for unattended operation; more compact.

PREFERRED OPERATING SPEED

One good check of most desirable operating speed is a survey of driver speeds in use. The chart shows how fast drivers operated on hundreds of installations. By more than 3:2 ratio over any other speed bracket, the preferred driver speed is about 1000 rpm.

What about the CUB? The CUB's rated speed is 1000 rpm. Thus the CUB, with direct drive at 1000 rpm, makes the preferred compressor package.



WHEN DO YOU TAKE GAS FROM A WELL?

When is it economical to take gas from a gas field or oil well? There is a tremendous difference in opinion.

It depends on price of contracts . . . on company policy of time limit on payout . . . on the alternatives for capital investment . . . and many other factors.

Not the least is, however, the economics of the installation—and particularly of the compression equipment.

The CUB brings important innovations to the economics of the installation. Its flexibility in use—plus its reliability and efficiency will combine to cut compressor operation costs sharply.

Remember, the CUB reflects the thinking of oil field men. You can take advantage of it with safety.
Write Worthington Corporation, Section 36-15, Harrison, N.J., for more information. In Canada, Worthington (Canada) Ltd., Brantford, Ontario. Or call your local compressor packager.

WORTHINGTON

PRODUCTS THAT WORK FOR YOUR PROFIT

Company, Plant, and Location (★ indicates cycling)	Nearest Town	M.M.c.f. daily Capacity	M.M.c.f. daily Through-put	Process Method	Production—Gallons Daily Propane	Isobutane	Normal Butane	LPG Mix	Combined Gaso.-LPG	Natural Gasoline	Other
TEXAS (Continued)											
Fashing short-cycle plant, Atascosa County	Karnes City	50.0	40.0	Ads.	.....	.....	.....	.....	.....	5,000	.....
★ Fort Chadbourne plant, Coke County	Bronte	30.0	28.0	Abs.	17,460	4,330	14,504	.....	.....	*10,970	[3]1,444
★ Opelika plant, Henderson County	Murchison	85.0	82.0	Abs.	.....	.....	9,387	.....	.....	*38,452	.....
Plant No. 108, Eastland County	Ranger	12.0	8.0	Abs.	.....	.....	.....	.....	¶(33,971)	.....	.....
RCF plant, Eastland County‖	Ranger	.....	.....	Abs.	13,436	5,772	26,573	.....	27,186	.....	[3]6,447
Luling Oil & Gas Co.											
★ Glen Cove plant, Coleman County	Glen Cove	5.0	5.0	Abs.	.....	.....	.....	4,335	.....	2,000	.....
Mertzon Corp.											
Mertzon field, Irion County	San Angelo	4.0	1.5	Refr.-ads.	.....	.....	.....	7,000	.....	3,000	.....
Mesquite Gas Products Co.											
Davis field, Upton County	Crane	6.0	2.0	Abs.	.....	.....	.....	.....	12,000	.....	.....
Midland Gasoline Corp.											
Conroe field, Montgomery County	Conroe	42.0	37.0	Abs.	20,000	.....	.....	.....	37,000	.....	.....
Midland Petrochemical Co.											
H. J. Strawn field, Tom Green County	Christoval	2.0	2.0	Refr.	.....	.....	.....	.....	**12,000	.....	.....
Susan Peak field, Tom Green County	San Angelo	3.0	3.0	Refr.	.....	.....	.....	.....	**13,000	.....	.....
Mobil Oil Co.											
Burkburnett field, Wichita County	Burkburnett	1.4	0.7	Refr.-abs.	2,760	.....	.....	.....	.....	8,200	.....
Desdemona field, Eastland County	Desdemona	1.3	1.1	Refr.-abs.	.....	.....	.....	3,270	.....	5,590	.....
Electra field, Wichita County	Electra	1.2	1.0	Refr.-abs.	.....	.....	.....	4,700	.....	5,490	.....
Kermit field, Winkler County	Kermit	10.0	8.0	Abs.	.....	.....	.....	5,680	.....	5,850	.....
Parks Ranch field, Midland County	Midland	12.5	7.6	Comp.	.....	.....	.....	.....	6,760	.....	.....
Pegasus field, Upton County	Midland	60.0	39.0	Abs.	66,700	.....	33,500	.....	.....	28,100	.....
Sabine plant, East Texas field, Gregg County	Kilgore	12.0	2.8	Refr.-abs. & Refr.	14,800	.....	9,770	.....	.....	7,850	.....
★ Seeligson field, Jim Wells County	Premont	249.0	200.0	Refr.-abs.	62,700	24,800	16,600	.....	.....	116,700	[1]50,000 [9]7,200
Vanderbilt plant, West Ranch field, Jackson County	Edna	75.0	53.0	Abs.	9,700	.....	.....	.....	31,700	.....	[10]400
Natural Gas Pipeline Co. of America											
★ Fritch plant, Panhandle field, Hutchinson County	Fritch	213.0	147.0	Abs.	.....	.....	.....	.....	.....	74,790	.....
★ Stinnett plant, Panhandle field, Moore County	Stinnett	179.0	94.0	Abs.	.....	.....	.....	.....	.....	43,360	.....
Natural Gasoline Corp.											
Hawkins plant, Wood County	.....	NR	11.0	Abs.	14,706	.....	.....	28,939	.....	19,556	.....
Northern Natural Gas Co.											
Spearman plant, Ochiltree County	Spearman	200.0	180.0	Refr.	.....	.....	.....	.....	.....	24,000	.....
Odessa Natural Gasoline Co.											
Inland plant, Foster field, Ector County	.....	5.5	5.5	Abs.	.....	.....	.....	7,000	.....	5,000	.....
Odessa plant, Foster field, Ector County	.....	40.0	25.0	Abs.	30,000	.....	30,000	.....	.....	30,000	.....
Ohio Oil Co.											
North Markham plant, North Bay City field, Matagorda County	Bay City	110.0	102.9	Refr.-abs.	.....	.....	17,667	46,620	.....	.....	.....
Phoenix Lake field, Orange County	Orange	12.0	11.2	Refr.-abs.	8,067	.....	6,817	.....	.....	4,746	.....
Pan American Petroleum Corp.											
★ Burnell-North Pettus field, Karnes and other counties	Pettus	187.0	158.0	Abs.	47,400	16,100	8,700	9,900	.....	99,400	†9,900
Hastings field, Brazoria and Galveston counties	Alvin	53.0	46.0	Refr.-abs.	9,200	4,600	1,300	2,100	.....	23,600	.....
La Blanca field, Hidalgo County	Weslaco	50.0	35.0	Ads.	.....	.....	.....	.....	4,494	.....	.....
Levelland field, Cochran and Hockley counties	Levelland	36.0	17.0	Abs.	12,800	.....	8,500	10,700	.....	17,600	.....
Luby and Petronilla fields, Nueces County	Bishop	37.0	31.0	Abs.	2,000	.....	.....	7,400	.....	23,300	.....
Midland Farms field, Andrews County	Andrews	15.0	10.0	Refr.	.....	.....	.....	.....	63,600	.....	.....
Monahans field, Winkler County	Wink	12.0	3.8	Refr.	.....	.....	.....	.....	13,300	.....	.....
North Cowden plant, Cowden field, Andrews County	Odessa	84.0	67.0	Abs.	58,200	.....	54,900	9,000	.....	59,200	.....
Old Ocean field, Brazoria County††	Sweeny	570.0	475.0	Refr.-abs.	163,000	50,000	46,000	.....	.....	112,000	[1]154,000 [3]26,000
Slaughter field, Cochran and Terry counties	Sundown	110.0	75.0	Abs.	70,000	.....	23,900	24,500	.....	73,500	.....
South Fullerton plant, Fullerton field, Andrews County	Andrews	58.0	50.3	Refr.-abs.	49,900	.....	28,300	15,200	.....	29,700	.....
Three Bar field, Andrews County	Andrews	18.0	16.0	Abs.	20,400	.....	10,800	17,400	.....	12,500	.....
Parade Co.											
East Texas field, Rusk County	Turnertown	5.3	5.2	Abs.	28,118	12,242	.....	.....	.....	29,412	.....

Company, Plant, and Location (★ indicates cycling)	Nearest Town	M.M.c.f. daily Capacity	M.M.c.f. daily Throughput	Process Method	Production—Gallons Daily Propane	Isobutane	Normal Butane	LPG Mix	Combined Gaso.-LPG	Natural Gasoline	Other
TEXAS (Continued)											
Pecos Company. (Plant now owned and operated by El Paso Natural)											
Santa Rosa field, Pecos County‡‡	Grand Falls	45.0	30.0	Abs.	15,000	.....	13,500	.....	.....	9,500	.....
Phillips Petroleum Co.**											
Andrews plant, various pools, Andrews County	Andrews	115.0	NR	Abs.	.....	.....	.....	.....	325,000	.....	.....
Bayou plant, Chocolate Bayou field, Brazoria County	Alvin	360.0	NR	Abs.	120,000	.....	155,000	.....	.....	135,000	.....
Benedum field, Upton County	Midkiff	85.0	NR	Abs.	120,000	.....	80,000	.....	.....	70,000	.....
Borger fractionator	(Processes products from 22 plants as footnoted.)										
Canadian plant, West Panhandle field, Hutchinson County	Phillips	25.0	NR	Abs.	.....	.....	.....	.....	100,000	.....	.....
Crane plant, McElroy field, Crane County	Crane	63.0	NR	Abs.	.....	.....	.....	.....	210,000	.....	.....
Dumas plant, West Panhandle field, Moore County	Phillips	240.0	NR	Abs.	.....	.....	.....	.....	290,000	.....	.....
★ Fullerton field, Andrews County	Frankel City	80.0	NR	Abs.	.....	.....	.....	.....	200,000	.....	.....
★ Goldsmith field, Ector County	Goldsmith	440.0	NR	Abs.	.....	.....	.....	.....	800,000	.....	.....
Gray plant, East Panhandle field, Gray County	Pampa	80.0	NR	Abs.	.....	.....	.....	.....	110,000	.....	.....
Hansford plant, West Panhandle field, Hansford County	Guymon	140.0	NR	Abs.	.....	.....	.....	.....	110,000	.....	.....
Judkins-Harper-South Cowden plant, Harper-Penwell-Jordan field, Ector County	Penwell	42.0	NR	Abs.	.....	.....	.....	.....	145,000	.....	.....
Lefors plant, East Panhandle field, Gray County	Pampa	54.0	NR	Abs.	.....	.....	.....	.....	70,000	.....	.....
North plant, East Panhandle field, Gray County	Pampa	5.5	NR	Abs.	.....	.....	.....	.....	40,000	.....	.....
Pampa plant, East Panhandle field, Gray County	Pampa	25.0	NR	Abs.	.....	.....	.....	.....	100,000	.....	.....
Pantex plant, West Panhandle field, Hutchinson County	Phillips	56.0	NR	Abs.	.....	.....	.....	.....	110,000	.....	.....
Pembrook field, Upton County	Midkiff	60.0	NR	Abs.	.....	.....	.....	.....	150,000	.....	.....
Puckett field, Pecos County	Crane	200.0	NR	Ads.	.....	.....	.....	.....	20,000	.....	.....
Rock Creek plant, West Panhandle field, Hutchinson County	Phillips	200.0	NR	Abs.	.....	.....	.....	.....	210,000	.....	.....
Sanford plant, West Panhandle field, Hutchinson County	Phillips	100.0	NR	Abs.	.....	.....	.....	.....	140,000	.....	.....
Seminole field, Gaines County	Seminole	35.0	NR	Abs.	.....	.....	.....	.....	80,000	.....	.....
Sherman plant, West Panhandle field, Hansford County	Guymon	380.0	NR	Abs.	.....	.....	.....	.....	240,000	.....	.....
Sneed plant, West Panhandle field, Moore County	Phillips	260.0	NR	Abs.	.....	.....	.....	.....	195,000	.....	.....
Spraberry plant, Tex-Harvey field, Midland County	Midland	60.0	NR	Abs.	.....	.....	.....	.....	150,000	.....	.....
Sweeny fractionator	(Processes products from 8 plants as footnoted.)										
Tunstill field, Reeves County	Orla	15.0	NR	Abs.	100,000	.....	37,000	.....	.....	50,000	.....
Winkler plant, Emperor field, Winkler County	Wink	15.0	NR	Abs.	.....	.....	.....	.....	25,000	.....	.....
Plomo Co.											
★ Brayton field, Nueces County	Robstown	60.0	45.0	Abs.	9,912	.....	6,485	.....	.....	24,864	[10]30,600 [11]232
Plymouth Oil Co.											
★ Plymouth field, San Patricio County	Sinton	65.0	42.0	Abs.	2,995	.....	.....	4,128	.....	13,255	.....
Pure Oil Co.											
Dollarhide field, Andrews County	Andrews	65.0	65.0	Comp. & abs.	93,000	.....	.....	.....	30,000	60,000	.....
Van field, Van Zandt County	Van	15.0	6.0	Comp. & abs.	11,300	.....	.....	.....	27,400	.....	.....
Reef Corp.											
East Vealmoor field, Howard and Borden counties	Big Spring	70.0	40.0	Abs. & refr.	152,000	18,000	64,000	.....	.....	66,000	.....
Renwar Oil Corp. (see Tennessee Gas Refining Co.)											
Richardson Gasoline Co., Sid											
Keystone field, Winkler County	Kermit	120.0	110.0	Refr.-abs.	60,000	.....	42,000	.....	.....	48,000	.....
Roger Lacy, Inc.											
★ Carthage plant, Panola County‡‡ (reportedly purchased from Lone Star Producing Co.)	Carthage	100.0	30.0	Abs.	.....	.....	.....	.....	.....	[8]20,204	[9]137
Runnels Gas Products Corp. (see Union Texas)											
Shamrock Oil & Gas Corp.											
McKee-Sunray plant, Panhandle field, Moore County	Sunray	350.0	299.0	Abs.	128,303	40,619	122,328	.....	.....	74,900	[3]27,030
Shell Oil Co.											
Big Foot field, Frio County	Devine	21.1	5.3	Ads.	.....	.....	.....	.....	.....	2,930	.....
Bryant No. 17 plant, Panhandle field, Carson County	Skellytown	15.0	10.0	Abs.	.....	.....	.....	.....	.....	30,000	.....
Crossett field, Upton County	McCamey	3.0	3.1	Refr.	3,100	.....	.....	.....	.....	5,200	.....
Provident City field, Lavaca County	Sheridan	80.0	75.0	Abs.	19,400	.....	.....	.....	.....	[8]82,000	.....
★ Sheridan field, Colorado County	Sheridan	130.0	115.0	Refr.-abs.	52,500	16,400	18,300	.....	.....	[8]123,000	[3]9,500

Company, Plant, and Location (★ indicates cycling)	Nearest Town	M.M.c.f. daily Capacity	M.M.c.f. daily Through-put	Process Method	Production—Gallons Daily Propane	Isobutane	Normal Butane	LPG Mix	Combined Gaso.-LPG	Natural Gasoline	Other
TEXAS (Continued)											
TXL field, Ector County	Notrees	112.0	102.0	Abs.	133,000	.....	83,500	.....	.....	75,500	.....
Wasson field, Yoakum County	Denver City	150.0	95.0	Abs.	120,000	.....	.....	.....	.....	138,500	.....
Sinclair Oil & Gas Co.											
Donna field, Hidalgo County	Alamo	40.0	35.0	Ads.	.....	.....	.....	.....	6,600	.....	.....
Eldorado (No. 23) plant, Hulldale field, Schleicher County	Eldorado	35.0	35.0	Abs.	22,000	.....	30,000	.....	.....	20,000	.....
Longview (No. 18) plant, East Texas field, Gregg County	Longview	17.0	7.0	Abs.	40,000	.....	30,000	.....	.....	20,000	.....
Price (No. 21) plant, East Texas field, Rusk County	Price	17.0	5.0	Abs.	18,000	.....	.....	.....	25,000	.....	.....
★ Silsbee (No. 25) plant, Hardin County	Silsbee	58.0	39.0	Abs.	23,000	12,000	12,000	.....	.....	36,000	.....
★ South Hampton (No. 26) plant, Hardin County	Silsbee	25.0	22.0	Abs.	12,000	.....	11,000	.....	.....	25,000	.....
Spring (No. 28) plant, Bender field, Montgomery County	Spring	6.0	5.0	Abs.	.....	.....	.....	3,000	.....	3,000	.....
Sweetwater (No. 27) plant, Sweetwater Canyon field, Nolan County	Sweetwater	7.0	5.0	Refr.	5,000	.....	10,000	.....	.....	5,000	.....
Taft (No. 20) plant, East White Point field, San Patricio County	Taft	21.0	15.0	Abs.	.....	.....	.....	4,000	.....	10,000	.....
Troup (No. 19) plant, East Texas field, Rusk and Smith counties	Troup	20.0	14.0	Abs.	8,000	4,000	2,000	.....	.....	20,000	.....
Skelly Oil Co.											
Schafer, Watkins, Crawford, and Kingsmill plants, Panhandle field, Hutchinson, Carson, and Gray counties	Skellytown	220.0	NR	Abs.	167,000	40,000	77,000	.....	.....	155,000	.....
Spearman plant, Hansford field, Ochiltree County	Spearman	52.0	NR	Refr.-abs.	29,000	.....	.....	33,000	.....	.....	.....
Southern Minerals Corp.											
Falls City field, Karnes County	Falls City	6.0	3.5	Refr.	.....	.....	.....	.....	.....	*3,000	.....
Saxet field, Nueces County	Corpus Christi	50.0	10.0	Abs.	.....	.....	.....	6,534	.....	9,113	.....
Stratton field, Nueces County	Bishop	65.0	31.0	Refr.-abs.	13,424	695	.....	.....	.....	7,280	.....
South-Tex Corp.											
★ Agua Dulce field, Nueces County	Banquette	80.0	50.0	Abs.	8,000	.....	.....	10,000	.....	21,000	°1,000
Standard Oil Co. of Texas											
Chevron field, Kleberg County	Corpus Christi	67.5	30.2	Ads.	.....	.....	.....	.....	.....	*13,270	.....
North Snyder plant, various fields, Scurry County	Snyder	30.0	11.1	Refr.	54,100	7,600	16,750	.....	.....	32,600	.....
Sherman plant, Grayson County	Sherman	20.0	10.2	Abs.	4,880	.....	.....	9,140	.....	5,250	.....
Sivells Bend field, Cooke County	Gainesville	5.0	2.8	Abs.	4,100	.....	.....	4,580	.....	3,920	.....
Sun Oil Co.											
Jameson plant, Coke County	.....	55.0	40.5	Comp. & Refr.	42,436	.....	29,567	.....	.....	30,781	.....
Sun plant, Starr County	Delmita	80.0	74.6	Abs.	22,732	.....	21,172	.....	.....	65,612	.....
Sunray Mid-Continent Oil Co.											
Carancahua Bay plant, Appling and Traylor Ranch fields, Jackson County (products moved by pipeline)	Laward	60.0	32.0	Refr.-abs.	.....	.....	.....	.....	31,391	.....	.....
Redfish Bay and Mustang Island fields, San Patricio County (products moved by pipeline)	Ingleside	140.0	161.0	Refr.-abs.	.....	.....	.....	.....	133,124	.....	.....
Snyder plant, Kelly-Snyder field, Scurry County	Snyder	75.0	31.5	Abs.	164,526	21,813	62,906	.....	.....	77,423	.....
Superior Oil Co.											
Lake Creek field, Montgomery County (fractionator for Ramsey)	Conroe	55.0	17.0	Abs.	26,071	6,246	7,305	.....	.....	*45,106	.....
Portilla field, San Patricio County	Sinton	12.0	9.0	Ads.	.....	.....	.....	.....	.....	1,350	.....
Ramsey field, Colorado County	Columbus	55.0	21.0	Refr.-abs.	(Fractionation at Lake Creek, listed above.)						
Tennessee Oil Refining Co. (division of Tennessee Gas Transmission Co.)											
Chesterville plant (transmission line), Colorado County	Eagle Lake	100.0	90.0	Refr.-abs.	19,000	11,500	.....	30,500	.....	24,000	.....
K. G. Pearce plant, Copano Bay field, Aransas County (products fractionated at La Porte)	Fulton	75.0	75.0	Refr.-abs.	.....	.....	.....	.....	80,000	.....	.....
La Porte fractionation plant, Harris County (receives mixed stream from various plants in the area)	.....	....	....	.....	(140,700)	(207,000)	(172,500)	.....	.....	(141,750)	.....
Mustang field, Nueces County	(Purchased from Renwar Oil Corp. Separation plant only.)										
R. R. Dean plant (transmission line), Nueces County (products fractionated at La Porte)	Agua Dulce	100.0	160.0	Refr.-abs.	.....	.....	.....	.....	88,000	.....	.....
West Rockport plant, Aransas County	(Purchased from Renwar Oil Corp. Separation plant only.)										
Texaco Inc.**											

Company, Plant, and Location (★ indicates cycling)	Nearest Town	M.M.c.f. daily Capacity	M.M.c.f. daily Through-put	Process Method	Production—Gallons Daily Propane	Isobutane	Normal Butane	LPG Mix	Combined Gaso.-LPG	Natural Gasoline	Other
TEXAS (Continued)											
Electra plant, Wichita County	Electra	2.2	NR	Abs.	3,000	.....	.....	16,000	.....	10,000	.....
Fuller plant, Scurry County	Snyder	28.0	NR	Abs.	54,000	.....	35,000	.....	.....	50,000	.....
Lamesa plant, Dawson County	Lamesa	5.5	NR	Refr.	.....	.....	.....	.....	22,800	.....	.....
West Jennings plant, Zapata County	San Ygnacio	4.5	NR	Refr.	.....	.....	.....	.....	.....	2,300	.....
Texas Gas Corp.											
Several fields, Jefferson County§§	Winnie	240.0	190.0	Refr.-abs.	39,900	22,260	25,200	.....	.....	.....	[1]22,260 [3]18,900 [5]201,600 [8]8,400 [9]46,200
Texas Gulf Producing Co.											
Headlee field, Ector County	Odessa	34.0	25.0	Abs.	.....	.....	.....	.....	130,000	.....	.....
Texas Pacific Coal & Oil Co.											
Veale Plant No. 3, Caddo field, Stephens County	Breckenridge	6.0	1.9	Abs.	.....	.....	5,009	.....	.....	6,156	.....
Velta plant, Pardue-Toler field, Fisher County	Hamlin	5.0	2.5	Abs.	3,959	.....	6,158	.....	.....	4,433	.....
Texas Petro Gas Co.	(Operates plant in Port Arthur area.)										
Tidewater Oil Co.											
Cayuga field, Anderson County	Cayuga	15.0	13.0	Refr.-abs.	.....	.....	.....	8,400	.....	8,400	.....
Long Lake field, Anderson County	Palestine	(Dismantled in 1960.)									
New Hope field, Franklin County	Winnsboro	50.0	50.0	Abs.	42,000	.....	64,000	.....	.....	279,000	.....
Palacios field, Matagorda County	Palacios	10.0	6.0	Ads.	.....	.....	.....	.....	.....	635	.....
West Bernard field, Wharton County	Eagle Lake	32.0	21.0	Abs.	.....	.....	.....	4,998	.....	14,280	.....
Trans-Jeff Chemical Corp.											
McMullen County	Tilden	(Sulfur recovery plant, adjacent to gas-treating plant.)									
Transwestern Pipeline Co.											
Pecos County	Fort Stockton	180.0	.....	(Removes CO_2 and H_2S.)							
Trinity Gas Corp.											
★ Sejita field, Duval County	Falfurrias	55.0	45.0	Abs.	10,000	.....	5,000	.....	.....	.....	[5]15,000 [9]2,000 [11]2,000
Turner & West											
Loving plant, Young County	Loving	2.0	1.8	Abs.	.....	.....	.....	4,500	.....	4,500	.....
Peter's plant, James pool, Young County	(Plant moved to New Mexico. See Horshoe Gallup Corp. listing.)										
Union Texas Natural Gasoline Corp.											
Benedum field, Upton County	Rankin	NR	60.0	Abs.	.....	.....	.....	.....	200,000	.....	.....
Cree-Sykes field, Runnels County (formerly listed as Runnels Gas Products Corp.)	Ballinger	NR	20.0	Refr.	.....	.....	.....	.....	55,000	.....	.....
Perkins plant, Jameson field, Coke County	Silver	NR	65.0	Abs.	.....	.....	.....	.....	260,000	.....	.....
Walnut Bend field, Cooke County	Gainesville	NR	16.0	Abs.	.....	.....	.....	.....	80,000	.....	.....
Wimberly field, Jones County	Abilene	NR	10.0	Refr.-abs.	.....	.....	.....	.....	60,000	.....	.....
United Gas Pipe Line Co.											
Agua Dulce field, Nueces County	Banquette	30.0	19.0	Abs.	.....	.....	.....	750	.....	*12,000	.....
Cabeza Creek field, Karnes County	Runge	100.0	75.0	Abs.	6,000	.....	10,000	22,000	.....	27,000	.....
Carthage field, Panola County	Carthage	220.0	210.0	Abs.	35,000	16,000	35,000	.....	.....	*120,000	[9]2,000
Karnes City plant, Coy City field, Karnes County	Karnes City	40.0	33.0	Abs.	2,500	.....	.....	5,000	.....	*10,800	.....
U. S. Bureau of Mines											
Amarillo helium plant	(This and Exell plant listed below are two of five government-operated helium plants.)										
Exell helium plant											
Warren Petroleum Corp.											
Breckenridge plant, Stephens County	.....	NR	7.0	Abs.	11,519	.....	.....	20,973	.....	15,536	.....
Fairbanks plant, Harris County	.....	NR	34.0	Abs.	.....	.....	.....	5,361	.....	10,292	.....
Fashing plant, Atascosa County	.....	NR	90.0	Refr.-Abs.	14,505	.....	.....	14,611	.....	28,404	.....
Fostoria plant, Montgomery County	.....	NR	19.0	Refr.-Abs.	.....	.....	.....	.....	22,703	.....	.....
Gladewater and Gregg-Tex plant, Gregg County	.....	NR	13.0	Abs.	61,153	.....	.....	34,206	.....	42,103	.....
Holliday plant, Archer County	.....	NR	10.0	Abs.	17,550	.....	.....	23,463	.....	16,014	.....
McLean plant, Wheeler County	.....	NR	24.0	Abs.	8,277	.....	.....	8,600	.....	49,818	.....

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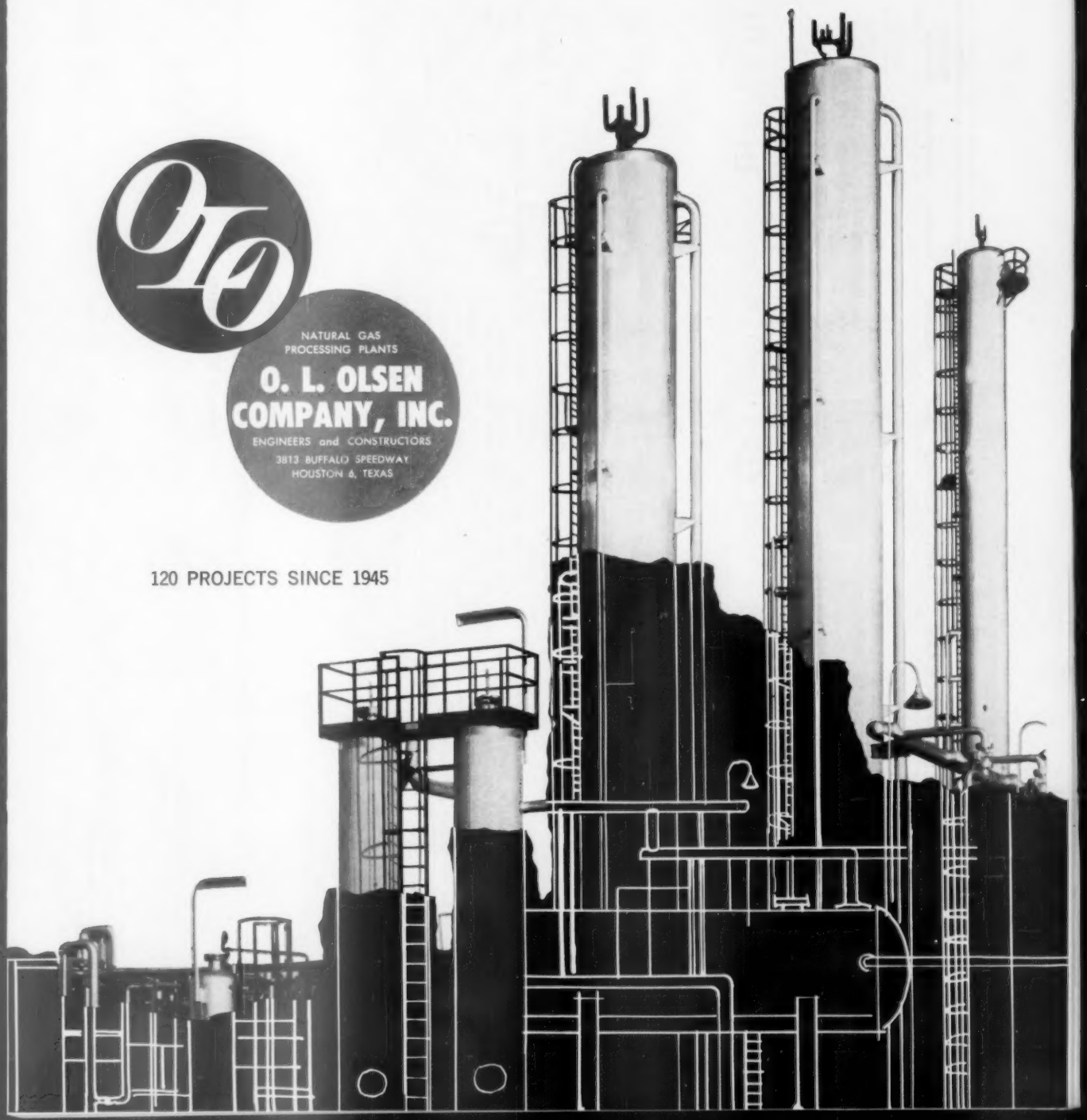

Company, Plant, and Location (★ indicates cycling)	Nearest Town	M.M.c.f. daily Capacity	M.M.c.f. daily Throughput	Process Method	Production—Gallons Daily Propane	Isobutane	Normal Butane	LPG Mix	Combined Gaso.-LPG	Natural Gasoline	Other
TEXAS (Continued)											
Monahans plant, Ward County		NR	20.0	Abs.	.....	.....	.....	.....	.....	18,143	.....
Runnels plant, Runnels County		NR	3.0	Abs.	.....	.....	.....	6,747	.....	2,914	.....
Spear plant, Gregg County		NR	6.0	Abs.	26,033	.....	.....	13,966	.....	25,538	.....
Waddell plant, Crane County		NR	85.0	Abs.	90,380	.....	.....	67,520	.....	52,834	.....
Wiseco plant, Wise County		NR	124.0	Abs.	101,154	.....	.....	73,932	.....	42,358	.....
Waskom Natural Gas Corp.											
Waskom field, Harrison County	Marshall	20.0	15.0	Abs.	.....	.....	.....	8,000	.....	.....	[5]66,000 [6]1,200 [8]6,300 [10]4,200
W-D Compression Co.											
Windham West field, Shackelford County	Abilene	2.5	1.0	Comp.	.....	.....	.....	.....	.....	.....	.....
West Gasoline Co.											
Hull field, Liberty County	Hull	20.0	3.0	NR	.....	.....	.....	900	.....	1,600	.....
West Texas CO_2 Co.											
Plant No. 1, Puckett field, Pecos County	Fort Stockton	3.0	1.1	Refr. & Comp.	.....	.....	.....	.....	.....	.....	†35,000
Whelan, D. E. and R. J.											
Whelan field, Harrison County	Marshall	20.0	5.5	Abs.	.....	.....	.....	.....	.....	1,210	.....
Woodlawn Processing Corp.											
Woodlawn field, Harrison County	Marshall	105.0	60.0	Abs.	.....	.....	.....	.....	.....	125,000	.....
Young, Marshall R.											
Cook field, Shackelford County	Albany	NR	4.5	NR	.....	.....	.....	.....	.....	2,900	.....
Total¶¶		18,854.2	14,164.0		4,687,636	752,424	2,430,281	910,311	6,298,580	6,254,802	1,883,992

*Includes heavier ends. †Fuel oil for Arkansas Louisiana Chemical and Pan American. Mixed petroleum products for Plomo Co. Liquid CO_2 for West Texas plant. ‡Remote booster stations gather gas from various fields for centralized processing. §Throughput and liquid volumes estimated. Plant began operations late in 1960. ¶Processed at Lone Star Producing's RCF plant. ‖Process raw condensate from Lone Star Producing's Brooks and 108 plants and Lone Star Gas Co.'s Gordon and Pueblo plants. **Capacity figures only. In Phillips Petroleum's case, products from Andrews, Canadian, Dumas, Fullerton, Goldsmith, Gray, Hansford, Judkins, Lefors, North, Pampa, Pantex, Rock Creek, Sanford, Seminole, Sherman, Sneed, and Winkler plants in Texas are further processed at Borger fractionator, as are products from Artesia, Eunice, Hobbs, and Lee plants in New Mexico. Products from Benedum, Crane, Goldsmith, Judkins, Pembrook, Puckett, Spraberry, and Winkler plants are further processed at Sweeny fractionator. ††This listing shows quantities anticipated for 1961 after additions to plant are on stream late 1960 or early 1961. ‡‡Figures are from 1960 survey. §§Production includes recovery from 6,500 bbl. per day of raw condensate charge. ¶¶Normal butane total includes butanes that are not split.

Utah

California Oil Co.											
Red Wash field, Uintah County		38.0	26.0	Refr.	.....	.....	.....	.....	.....	*11,550	.....
El Paso Natural Gas Co.											
Aneth plant, San Juan County	Blanding	100.0	73.0	Abs.	.....	.....	.....	.....	†(280,500)	.....	.....
Mountain Fuel Supply Co.											
Clay Basin field, Daggett County	Manila	22.0	10.0	Refr.	.....	.....	.....	.....	.....	*435	.....
Total		160.0	109.0		.....	.....	.....	.....	.....	11,985	.....

*Includes heavier ends. †Products separated at Wingate, N. M., plant.

West Virginia

Hope Natural Gas Co.											
Hastings byproducts plant, Wetzel County	Hastings	250.0	114.0	Abs.	43,823	.....	48,235	.....	.....	36,679	.....
Owens, Libbey-Owens Gas Department											
★South Malden plant, Kanawha County	Charleston	25.0	16.0	Abs.	5,000	.....	4,000	.....	.....	5,000	.....
Pure Oil Co.											
Dawes plant, Cabin Creek field, Kanawha County	Comfort	3.0	2.8	Refr. & Comp.	.....	.....	.....	4,200	.....	.....	.....
South Penn Oil Co., West Virginia Division											
24 small compression plants*		NR	19.1	Comp.	.....	.....	.....	.....	.....	16,400	.....
United Fuel Gas Co.											
Cobb plant, Kanawha County	Charleston	85.0	41.0	Abs.	.....	.....	.....	39,000	.....	9,000	.....

Company, Plant, and Location (★ indicates cycling)	Nearest Town	M.M.c.f. daily Capacity	M.M.c.f. daily Throughput	Process Method	Production—Gallons Daily Propane	Isobutane	Normal Butane	LPG Mix	Combined Gaso.-LPG	Natural Gasoline	Other
WEST VIRGINIA (Continued)											
Elk plant, Kanawha County	Charleston	35.0	3.0	Abs.	4,200	.....	1,000	.....	.....	2,300	.....
Kenova extraction plant, Wayne County	Huntington	170.0	113.0	Refr.-abs.	.....	.....	.....	.....	†(234,000)	.....	.....
Total		592.0	308.9		53,023	.....	53,235	43,200	.....	69,379	.....

*Throughput figure is from last year's report for 23 of the plants. Production figure is from 1961 survey. †See Columbia Hydrocarbon's Siloam, Ky., plant where liquids are separated.

Wyoming

Cabot Corp.											
Glenrock plant, South Glenrock field, Converse County	Glenrock	8.0	5.0	Refr.	22,532	.....	8,394	.....	.....	15,404	.....
Continental Oil Co.											
Sussex field, Johnson County	Linch	15.0	15.6	Refr.	16,632	.....	11,036	.....	.....	6,864	.....
El Paso Natural Gas Co.											
Opal plant, Lincoln County	Opal	250.0	213.0	Abs.	79,400	.....	16,200	.....	69,100	.....	.....
Mobil Oil Co.											
Big Horn plant, Manderson field, Big Horn County	Worland	(Permanently shut down mid-1960.)									
Mountain Fuel Supply Co.											
Church Buttes field, Uinta County	Lyman	100.0	55.0	Abs.	.....	.....	.....	.....	.....	*1,200	.....
Ohio Oil Co.											
Lance Creek field, Niobrara County	Lance Creek	5.0	3.2	Refr.-abs.	6,133	.....	5,405	.....	.....	6,860	.....
McFadden plant, Rock River field, Carbon County	Rock River	2.5	1.4	Refr.-abs.	3,457	.....	2,390	.....	.....	1,779	.....
Pan American Petroleum Corp.											
Beaver Creek field, Fremont County	Riverton	66.0	26.0	Refr.-abs.	7,500	.....	6,900	.....	.....	5,200	.....
Cottonwood Creek field, Washakie County	Worland	18.0	16.3	Ads.	.....	.....	.....	.....	5,000	.....	.....
Elk Basin field, Park County	Powell	12.0	13.2	Abs.	17,600	.....	26,100	.....	.....	36,400	.....
★ Salt Creek field, Natrona County	Midwest	25.0	18.0	Abs.	17,600	.....	38,900	.....	.....	42,800	.....
Pure Oil Co.											
Worland field, Washakie County	Worland	60.0	53.0	Abs.	34,000	6,000	.....	.....	32,000	.....	.....
Sinclair Oil & Gas Co.											
Bairoil (No. 22) plant, Lost Soldier field, Sweetwater County	Bairoil	9.0	7.0	Comp.	.....	.....	.....	.....	.....	8,000	.....
Total†		570.5	426.7		204,854	6,000	115,325	.....	106,100	124,507	.....

*Includes heavier ends. †Normal butane total includes butanes that are not split.

Journal Survey of Gas-Processing Plants in Canada

Province Capacities as of January 1, 1961, and Average Production

Province—	No. plants	M.M.c.f. Daily Capacity	M.M.c.f. Daily Throughput	Production—Gallons Daily Propane	Isobutane	Normal Butane	LPG Mix	Combined Gaso.-LPG	Natural Gasoline	Other	Total Products
Alberta	42	1,671.6	1,165.8	242,500	17,640	250,800	18,000	12,400	546,285	.....	1,087,625
British Columbia	2	300.0	250.0	17,500	8,750	17,500	.....	.....	87,500	.....	131,250
Ontario	1	16.0	9.0	.....	.....	.....	.....	.....	.....	.....	.....
Saskatchewan	5	129.7	86.2	43,600	5,000	18,300	.....	.....	25,869	.....	92,769
Total	50	2,117.3	1,511.0	303,600	31,390	286,600	18,000	12,400	659,654	.....	1,311,644

Canadian Plant Capacities as of January 1, 1961, and Average Production

Note: Legend for identifying products in last column is found at beginning of U. S. gas-processing plant survey.

Alberta

Company, Plant, and Location	Nearest Town	M.M.c.f. daily		Process Method	Production—Gallons Daily						
		Capacity	Through-put		Propane	Isobutane	Normal Butane	LPG Mix	Combined Gaso.-LPG	Natural Gasoline	Other
Ajax Processors, Ltd.											
St. Albert field	Edmonton	(See Canadian Industrial Gas Processors, Ltd.)									
Anglo American Exploration, Ltd.											
Hartell plant	Hartell	10.0	4.5	Abs.	.....	940	.....	.....	.....	3,930	.....
British American Oil Co., Ltd.											
Gilby plant	.....	15.0	12.0	Ads.	.....	.....	.....	.....	.....	*6,300	.....
Nevis plant, Nevis, Fenn, Big Valley, and Stettler fields	Stettler	35.0	20.0	Refr.	9,000	.....	8,000	.....	.....	9,000	.....
Pincher Creek field	Pincher Creek	204.0	148.0	Abs.	13,000	.....	23,000	.....	.....	*127,000	.....
Rimbey plant	Rimbey	326.0	....	Refr.	†68,000	.....	†98,000	.....	.....	†32,500	.....
California Standard Co.											
Nevis field	Red Deer	43.5	21.0	Refr.	.....	.....	.....	.....	.....	*14,100	.....
Princess field	Calgary	12.0	5.1	Ads.	.....	.....	.....	.....	.....	.....	.....
Sunnynook plant (on stream December 1960)	Sunnynook	12.0	....	Ads.	.....	.....	.....	.....	.....	.....	.....
Canadian Chieftain Petroleums, Ltd.											
Chieftain Mac Consort plant, Provost field	Edmonton	10.0	4.0	Ads.	.....	.....	.....	.....	.....	84	.....
Canadian Export Gas & Oil, Ltd.											
Sedalia field	Hanna	5.0	2.0	Ads.	.....	.....	.....	.....	.....	60	.....
Steveville plant, Cessford field	Calgary	22.0	12.0	Ads.	.....	.....	.....	.....	.....	850	.....
Wood River field	Red Deer	5.0	2.0	Ads.	.....	.....	.....	.....	.....	250	.....
Canadian Fina Oil, Ltd.											
Samson field	Wetaskiwin	20.0	20.0	Refr.	.....	.....	.....	.....	5,880	.....	.....
Windfall plant	Whitecourt	(This stage-separation process now operated by Pan American Petroleum Corp.)									
Canadian Kewanee, Ltd.											
Cankee plant, Cessford pool	Hanna	20.0	7.4	Ads.	.....	.....	.....	.....	.....	1,270	.....
Canadian Industrial Gas Processors, Ltd.											
St. Albert plant (Ajax Processors formerly listed as operator)	Edmonton	19.0	24.9	Abs.	.....	.....	.....	.....	.....	4,774	.....
Canadian Oil Companies, Ltd.											
Innisfail Leduc Reef Unit, Innisfail field	Red Deer	11.3	†8.0	Refr.	.....	.....	.....	.....	†2,520	.....	.....
Canadian Pacific Oil & Gas, Ltd.											
Makepeace plant, Hussar field	Calgary	20.0	11.0	Ads.	.....	.....	.....	.....	.....	610	.....
Canadian Superior Oil of California, Ltd.											
Harmattan-Elkton field	Calgary	15.0	8.0	Comp.	.....	.....	.....	.....	.....	.....	.....
Canex Gas, Ltd.											
Steveville plant, South Cessford field	Calgary	22.0	12.0	Abs.	.....	.....	.....	.....	.....	850	.....
Goliad Oil & Gas Co. and Goliad, Ltd.											
Pembina field	Edmonton	92.0	‡60.0	.....	36,000	13,200	36,000	.....	.....	36,000	.....
Home Oil Co., Ltd.											
Carstairs Elkton Unit	Calgary	75.0	54.0	Refr.	.....	.....	.....	.....	.....	*80,000	.....
Honolulu Oil Corp.											
Three Hills Creek field	Innisfail	5.0	†5.0	Ads.	.....	.....	.....	.....	.....	†2,200	.....
Hudson's Bay Oil & Gas Co., Ltd.											
Cessford field	Calgary	125.0	82.0	Refr.	.....	.....	.....	.....	.....	5,850	.....
Oyen field	Calgary	3.0	1.2	Ads.	.....	.....	.....	.....	.....	Negligible	.....
Imperial Oil Ltd.											
Golden Spike field	Edmonton	14.0	7.5	Comp.	.....	.....	.....	.....	§(14,000)	.....	.....
Leduc Plant No. 1	Devon	32.0	27.5	Comp.-refr.	32,300	.....	25,500	.....	.....	13,000	.....
Redwater plant	Redwater	10.0	4.2	Comp.-refr.	9,500	.....	7,300	.....	.....	3,300	.....
Kerr-McGee Oil Industries, Inc.											
Sylvan Lake plant, Prevo field	Red Deer	5.0	3.0	Ads.	.....	.....	.....	.....	.....	879	.....

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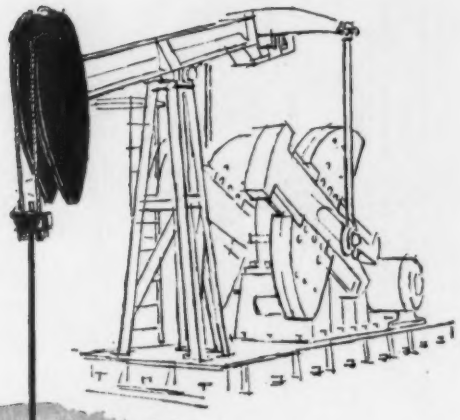

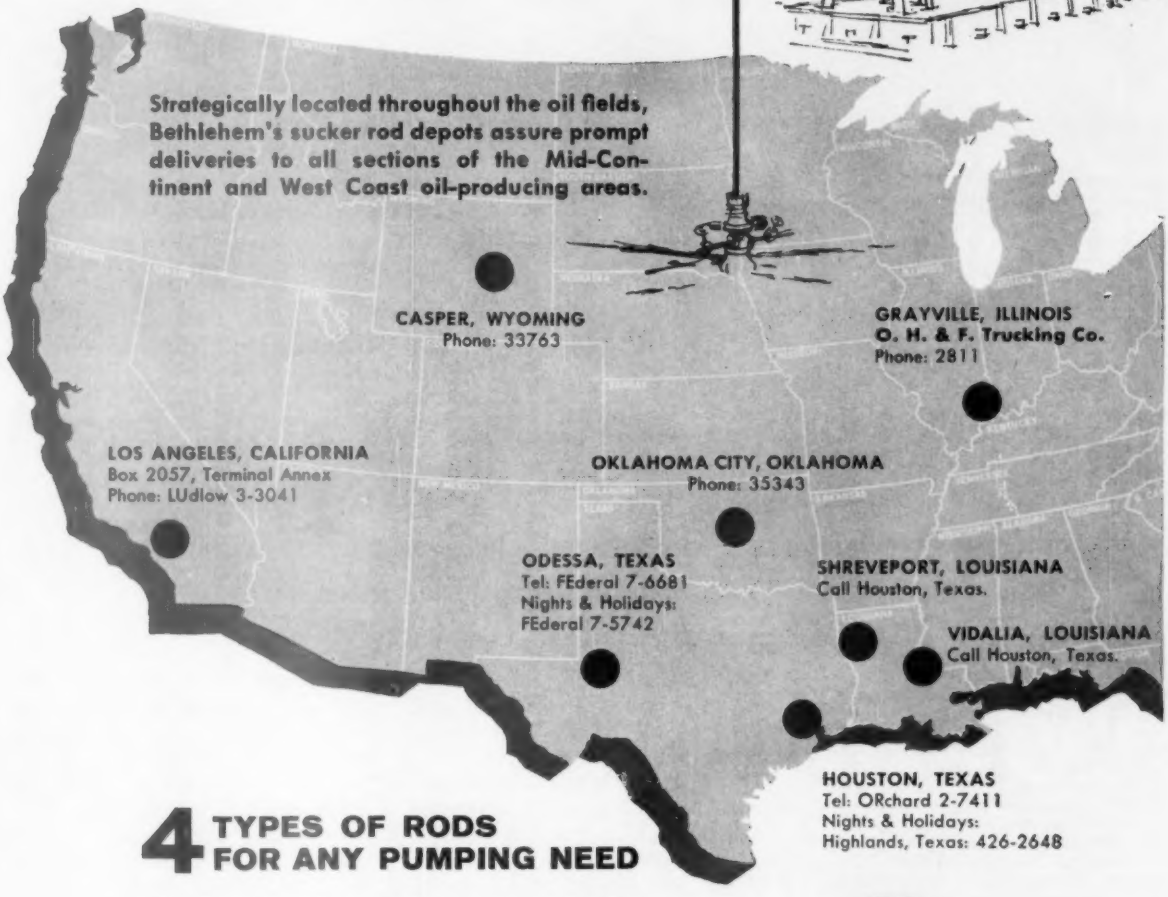

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Company, Plant, and Location	Nearest Town	M.M.c.f. daily Capacity	M.M.c.f. daily Through-put	Process Method	Production—Gallons Daily Propane	Isobutane	Normal Butane	LPG Mix	Combined Gaso.-LPG	Natural Gasoline	Other
ALBERTA (Continued)											
Mid-Western Industrial Processors, Ltd.											
Alexander Indian Reservation	Edmonton	55.0	47.5	Refr.	.....	.....	.....	.....	.....	6,440	.....
Progas, Ltd.											
Acheson field	Edmonton	5.0	2.0	Abs.	7,500	3,500	.....	.....	.....	1,750	.....
Provo Gas Producers, Ltd.											
Provost field	Consort	90.0	50.0	Abs. & Ads.	.....	.....	.....	.....	4,000	.....	.....
Royalite Oil Co., Ltd.											
Turner Valley field	Calgary	100.0	45.0	Abs.	19,200	.....	.....	.....	.....	50,400	.....
Shell Oil Co. of Canada, Ltd.											
Jumping Pound field	Calgary	90.0	Varies	Refr. & Abs.	.....	.....	.....	.....	.....	84,000	.....
Tennessee Gas Transmission Co.											
Hussar field	Standard	37.5	40.0	Refr.	.....	.....	.....	.....	.....	7,850	.....
Rosedale plant, Wayne-Rosedale field	Drumheller	5.3	4.6	Ads.	.....	.....	.....	.....	.....	1,670	.....
Texaco Exploration Co.											
Bonnie Glen field	Edmonton	32.0	29.0	Abs. & Comp.	48,000	.....	53,000	.....	.....	37,000	.....
Cynthia plant, Pembina field	Edmonton	10.0	8.0	Refr. & Comp.	.....	.....	.....	18,000	.....	7,000	.....
Gilby field	Red Deer	18.0	13.0	Ads.	.....	.....	.....	.....	.....	7,000	.....
Texas Gulf Sulphur Co.											
Okotoks field	Calgary	30.0	12.0	Abs.	(The only products are sales gas and sulfur.)						
Tidal Petroleum Corp., Ltd.											
Cessford field	Calgary	8.0	5.0	Ads.	.....	.....	.....	.....	.....	168	.....
Western Leaseholds, Ltd. (operated by Canadian Fina Oil, Ltd.)											
Samson plant	Wetaskiwin	3.0	1.4	Refr.	.....	.....	.....	.....	.....	200	.....
Total¶		1,671.6	1,165.8		242,500	17,640	250,800	18,000	12,400	546,285	.....

*Includes heavier ends. †Plant recently went on stream. Figures are estimated. ‡Processed at eight satellites which deliver raw make to Goliad Oil & Gas Co. fractionation plant. §Fractionated at Imperial's Leduc plant. ¶Normal butane total includes butanes that are not split.

British Columbia

Jefferson Lake Petrochemicals of Canada, Ltd.											
Peace River sulfur plant	Taylor	(Hydrogen sulfide gas obtained from McMahon plant.)									
Pacific Petroleums, Ltd. (formerly Phillips Petroleum Co.)											
McMahon plant	Fort St. John	300.0	250.0	Abs.	17,500	8,750	17,500	.....	.....	87,500	.....

Ontario

Union Gas Co. of Canada, Ltd.											
Tilbury field, Kent County	Chatham	16.0	9.0	(Compression, purification, and dehydration.)							

Saskatchewan

Imperial Oil Ltd.											
Nottingham Gas, Ltd., plant	Nottingham	8.5	6.0	Comp.-refr.	3,600	.....	3,300	.....	.....	2,800	.....
Smiley gas conservation plant	Smiley	3.2	3.2	Comp.-refr.	.....	.....	.....	.....	.....	2,050	.....
Saskatchewan Power Corp.											
Coleville plant, Coleville-Smiley field	Saskatoon	60.0	37.0	Abs.	.....	.....	.....	.....	.....	4,619	.....
Success plant, East Cantuar field	Swift Current	25.0	10.0	Ads.	.....	.....	.....	.....	.....	1,400	.....
Steelman Gas, Ltd.											
Steelman field	Estevan	33.0	30.0	Abs. & Refr.	40,000	5,000	15,000	.....	.....	15,000	.....
Total		129.7	86.2		43,600	5,000	18,300	.....	.....	25,869	.....

SHORT-CYCLE UNITS, like this one, are becoming increasingly important in gas processing, particularly in Texas, Louisiana, and Canada. This photo shows one constructed by Black, Sivalls & Bryson, Inc. Adsorption units can handle lean gas in small or large volumes.

Gas-Processing Construction:

More than 50 projects to hike capacity

- New survey shows 45 U. S. and 10 Canadian projects planned, under way, or just completed. These include one of the world's largest in Kansas, and three new helium-extraction plants in Southwest.

CONSTRUCTION of new plants and expansion of old ones will mean more capacity and a higher output of liquids for this growing branch of the industry.

The Oil and Gas Journal's latest survey shows 55 new projects just completed, under way, or planned.

Among them is Northern Gas Products Co.'s Bushton, Kans., plant which will have capacity of 900 M.M.c.f. daily, one of the largest in the world.

The past few months has brought announcements of three new helium-extraction plants in Arizona, Kansas, and Texas.

Here is a quick rundown of the 45 new U. S. projects and the 10 projects in Canada:

ACADIA CORP. is expanding its plant in Acadia Parish, Louisiana, by 65 M.M.c.f. daily, with completion early summer 1961. Present capacity is 130 M.M.c.f. daily. New liquids recovery is expected to amount to 100,000 gal. per day. Contractor is Hudson Engineering Corp., Houston. Process method is absorption.

ATLANTIC REFINING CO. will expand its Block 31 plant in Crane County, Texas. Existing capacity is 68 M.M.c.f. daily, and production averages more than 125,600 gal. per day. The expansion will increase recovery by 30,000 gal. per day. Process method is refrigeration.

Atlantic will build a plant in Live Oak County near George West, Tex., with capacity of 60 M.M.c.f. daily and recovery of more than 57,500 gal. of liquids daily. Process will be refrigeration. Completion expected first quarter 1962.

At Tompsonville Northeast field near Hebbronville, Tex., Atlantic is building an adsorption unit with capacity of 100 M.M.c.f. daily. Expected recovery is 9,990 gal. of liquids daily.

CALIFORNIA OIL CO. was to go on stream in March 1961 with a new refrigeration unit at Marietta, Okla. Capacity is 50 M.M.c.f. daily, with expected recovery of 327,000 gal. of liquids per day. Cycling will be conducted. Fish Engineering Corp., Houston, is contractor.

CANADIAN FINA OIL, LTD., is planning a new plant at Wildcat Hills, Alta., with capacity of 80 M.M.c.f. daily and recovery of 42,000 gal. per day of liquids. Completion expected January 1962.

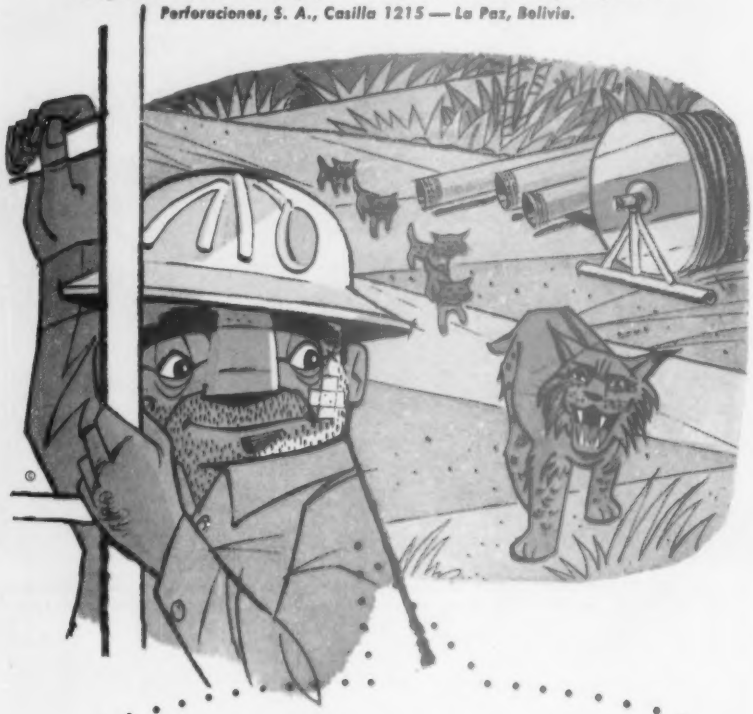
CANADIAN SUPERIOR OIL OF CALIFORNIA, LTD., will add 100 M.M.c.f. daily capacity to its small plant in the Harmattan-Elkton unit near Calgary, Alta. Additional recovery will be 210,000 gal. per day when completed November 1961. Present capacity of the plant is 15 M.M.c.f. daily. Cycling will be conducted. Process methods are compression and refrigeration.

CONTINENTAL OIL CO. completed expansion of its Louisiana Gas System plant near Lake Charles in Calcasieu Parish in January 1961. Capacity was expanded from 100 to 150 M.M.c.f. daily. Liquids recovery was increased from 103,000 to 158,000 gal. per day. Hudson Engineering Corp., Houston, had contract.

Also completed in January was a new Continental adsorption plant near Grand Chenier, Cameron Parish, 4 miles southeast of Lake Charles, La. Capacity is 175 M.M.c.f. daily, and expected liquids recovery 40,000 gal. per day. Delta Tank Manufacturing Co. was contractor.

Continental was to complete its new Medford plant, Southeast Eureka field, Grant County, Oklahoma, in March 1961. Capacity is 30 M.M.c.f. daily, with expected recovery of 29,000 gal. per day.

Congrats and $25 for this quip to FABIO SORIA GALVARRO, Compañia de Perforaciones, S. A., Casilla 1215 — La Paz, Bolivia.



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R. L. Frailey, Inc., Perry, Okla., was contractor for the refrigerated-absorption type unit.

EL PASO NATURAL GAS CO. will start construction this summer of new plant to process up to 650 M.M.c.f. daily near Jal, N. M. Recovery is expected to amount to about 588,000 gal. daily.

FLORIDA HYDROCARBONS CO. plans a new plant with capacity of 330 M.M.c.f. daily at Brooker, Fla., about 45 miles southwest of Jacksonville, contingent on completion of arrangements to increase pipeline capacity from 275 to 370 M.M.c.f. daily. Completion of the plant would be second quarter of 1962 at a cost of about $7,000,000. Recovery would include 45,000 gal. per day of natural gasoline and 90,000 gal. per day of butane.

GAS PRODUCTS CORP. completed a 2 M.M.c.f. daily expansion program at its Norfolk field plant in Payne County, Oklahoma, in March 1961. Recovery is expected to be 2,000 gal. per day. Expansion involved adding two compressors, stabilizing tower, and refrigeration unit. Former throughput was 0.5 M.M.c.f. daily, with recovery of 200 gal. per day.

GOLIAD CORP. is to expand its 450 M.M. c.f. daily plant at Cow Island, Vermilion Parish, Louisiana, to about 600 M.M.c.f. daily in 1961.

HELIUM CONSERVATION CORP., Midland, Tex., has filed for a permit to process helium from gas produced in the White Deer area of the Texas Panhandle. Plans call for a gathering system and a $3,000,000 extraction plant 3 miles northeast of White Deer. Initial capacity would be 50 M.M.c.f. daily. Graridge Corp. would be plant operator.

HELIUM, INC. (owned jointly by Kansas-Nebraska Natural Gas Co. and Linde Co., subsidiary of Union Carbide Co.) plans to build a plant to extract helium from natural gas near Scott City, Kans. Application submitted to U. S. Bureau of Mines.

HOME OIL CO. will add refrigeration facilities to its Carstairs-Elkton unit plant near Calgary, Alta., at cost of $1,300,000. Completion set for January 1, 1962. Present capacity is 75 M.M.c.f. daily. Expansion will add 40 M.M.c.f. daily, with 50,000 gal. per day of condensate and 9,000 gal. per day of natural gasoline recovery.

HUDSON'S BAY OIL & GAS CO., LTD., is designing a new dehydration plant at Pine Creek field, Alta., with capacity of 160 M.M.c.f. daily. Completion set for December 1961.

HUNT OIL CO. will start construction of a $2,000,000 plant near McGregor, N. D., this spring. The plant will have capacity of 10 M.M.c.f. daily from the North Tioga and McGregor fields. Liquids recovery will include 15,000 gal. per day of propane, 10,000 of butanes, and 7,000 of natural gasoline, as well as 8 long tons of sulfur per day. Process will be refrigerated-absorption.

Hunt completed a plant in Allen Parish near Kinder, La., in February 1961. It has capacity of 25 M.M.c.f. daily and an expected recovery of 34,000 gal. per day of liquids. Tears Engineers, Dallas, had the contract for the refrigerated-absorption unit.

JEFFERSON LAKE PETROCHEMICALS OF CANADA, LTD., is nearing completion of detailed engineering on a new 150 M.M.c.f. daily raw gas plant in the East Calgary, Alta., producing area. Recovery will include 93,000 gal. per day of condensate, 863 long tons per day of sulfur, and 100 M.M.c.f. daily of pipeline gas, when completed November 1, 1961. Ralph M. Parsons Co. of Canada, Ltd., Toronto, is contractor. Cost will be about $13,000,000.

KERR-McGEE OIL INDUSTRIES, INC., has announced plans to build a helium-extraction plant at Pinta field, Apache County, Arizona, where the gas contains about 8% helium. Design capacity is 2.5 M.M.c.f. daily.

LOMITA GASOLINE CO. is increasing capacity of its absorption plant in Long Beach field, Los Angeles County, California, from 60 to 67 M.M.c.f. daily, with completion March 1961. Liquids recovery will be increased from 83,000 to 133,000 gal. per day.

MOBIL OIL OF CANADA, LTD., has in the early planning stage a new 30 M.M.c.f. daily plant in the Wimborne area of Alberta.

NGL CORP. plans a plant to process 20,000 bbl. per day of gas condensate and/or natural gasoline on the Sabine River, south of Orange, Tex. Products would amount to 800,000 gal. per day, using a Universal Oil Products Co. process. Completion date is indefinite. Estimated cost is $9,500,000.

NORTHERN GAS PRODUCTS CO., subsidiary of Northern Natural Gas Co., will build a plant with capacity of 900 M.M.c.f. daily at Bushton, Kans., in the Rice and Ellsworth county area. Cost will be in excess of $9,000,000. Fluor Corp., Ltd., Los Angeles, has the contract. This will be one of the largest facilities of its kind.

PAN AMERICAN PETROLEUM CORP. plans to expand its plant in Elk Basin field, Park County, Wyoming, with completion in 1961. Capacity of the plant is currently 12 M.M.c.f. daily.

Pan American is under way with its new Whitecourt, Alta., plant, which will have 200 M.M.c.f. daily capacity when completed by Brown & Root, Inc., in 1962. Products are expected to amount to 610,000 gal. per day. It will serve Windfall, Pine Creek, and Beaver Creek fields. Pressure-maintenance facilities will involve 160 M.M.c.f. daily.

PHILLIPS PETROLEUM CO. expects to complete its new plant at X-Ray field, Erath County, Texas, in April 1961. Capacity will be 25 M.M.c.f. daily, with liquids recovery of 50,000 gal. per day. Absorption type unit.

PLOMO CO. completed expansion of its plant in Brayton field, Nueces County, near Robstown, Tex., in January 1961. Capacity of 60 M.M.c.f. daily was boosted by 25 M.M.c.f. daily, and liquids production was increased by nearly 5,000 gal. per day.

PORT GAS & PROCESSING CO., a division of Hudson Gas & Oil Co., will go on stream with a new plant near Port Arthur, Tex., in the summer 1961. It is designed to process as much as 150 M.M.c.f. daily.

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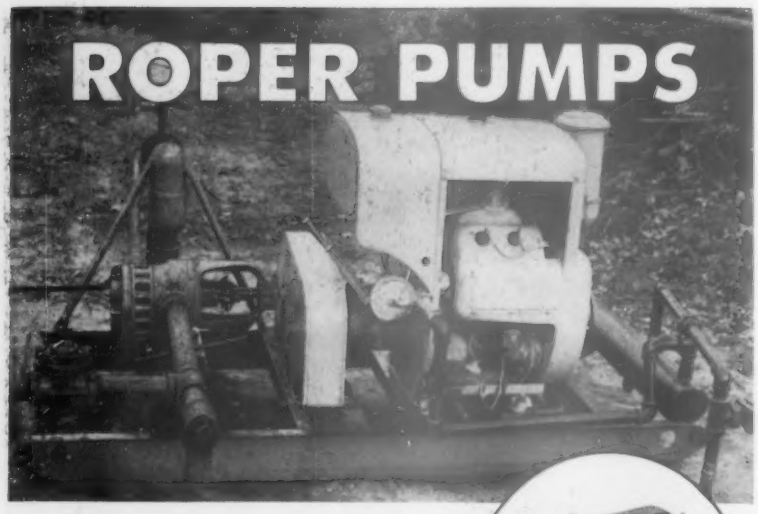

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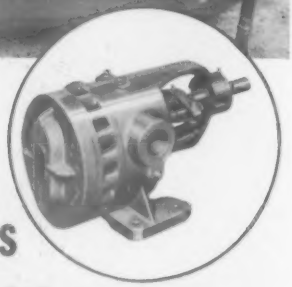

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COMMERCE, GEORGIA

SARATOGA PROCESSING CO., LTD. (Westcoast Transmission Co., Ltd.) plans to build a plant with capacity of 75 M.M.c.f. daily at Coleman, Alta. The plant will treat sour gas from Savanna Creek field and deliver pipeline gas to El Paso Natural Gas Co. at the border. Completion is set for November 1, 1961. Canadian Bechtel, Ltd., Toronto, has contract. Products will include 370 long tons of sulfur per day.

SHELL OIL CO. was scheduled to complete expansion of its Crossett plant in Upton County, Texas, first quarter 1961. Capacity is being hiked from 3 to 4.5 M.M.c.f. daily. Liquids recovery is being increased from 8,300 to 14,800 gal. per day. Dresser Engineering Co., Tulsa, has the contract for the refrigeration process.

Shell is doubling capacity of its Little Creek plant in Pike County, Mississippi, to 10 M.M.c.f. daily. Products, which now average 17,500 gal. per day, will be increased to 32,500 gal. per day. Completion set for 1961. Process is refrigeration.

Shell will complete a new absorption-refrigeration type plant at North Rincon field, Starr County, Texas, summer 1961. It will have capacity of 35 M.M.c.f. daily. Expected recovery is 15,500 gal. per day of propane, 14,000 of LPG mix, and 7,900 of natural gasoline. Contractor is Fish Engineering Corp., Houston.

Shell's Provident City plant expansion in Lavaca County, Texas, was due on stream first quarter 1961. Before expansion, capacity of the plant was 80 M.M.c.f. daily with production of 101,400 gal. per day. The expansion will increase this by 17,000 gal. daily. Contractor for the refrigeration unit is Gasoline Plant Construction Corp., Houston.

Shell will complete a new absorption-refrigeration plant at Sealy field, Austin County, Texas, in 1961. Capacity will be 16 M.M.c.f. daily, with expected recovery of 20,500 gal. per day.

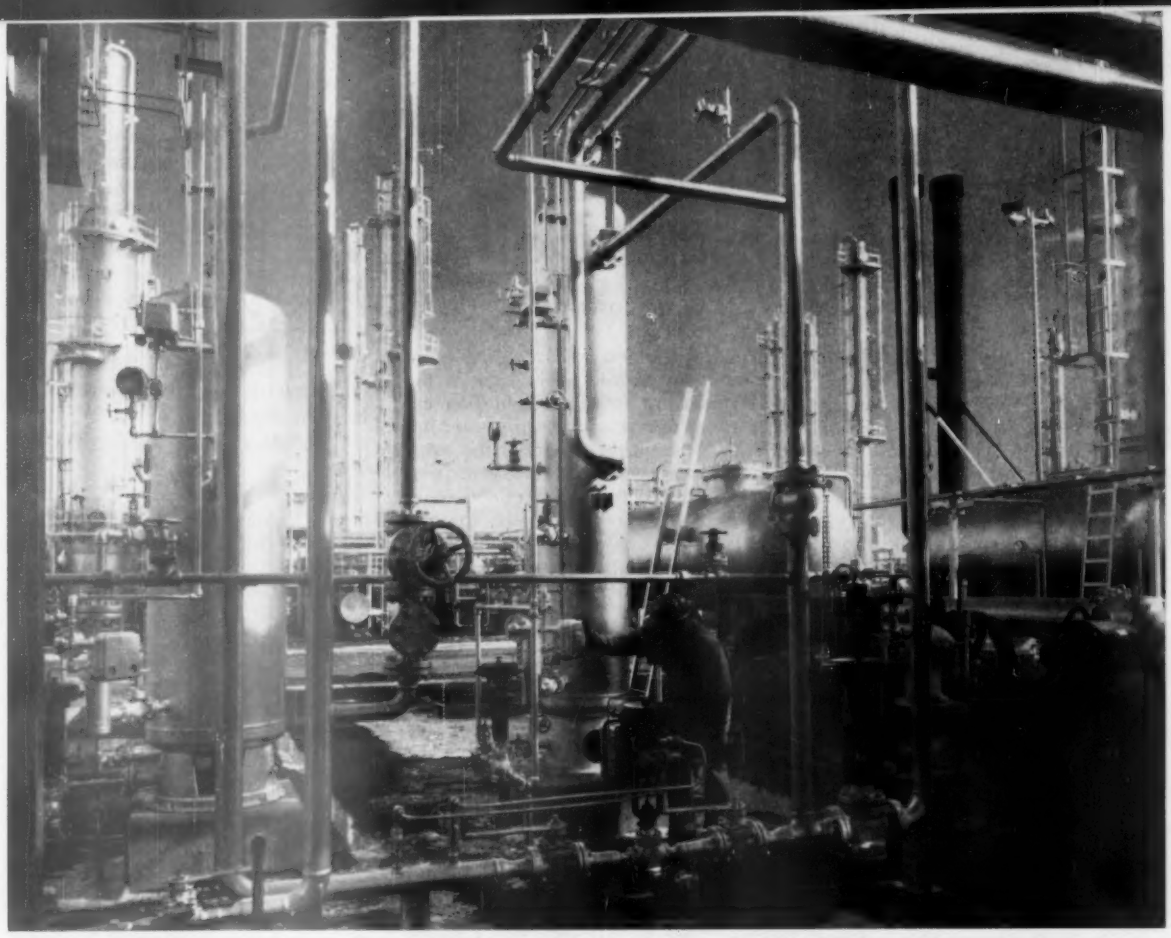
At Shell's Sheridan plant in Colorado County, Texas, the present 130 M.M.c.f. daily capacity will be expanded in 1961. Present liquids production is 219,700 gal. per day, with expansion to boost this by an expected 89,000 gal. per day. The expansion is for recovery and sale of ethane-propane concentrate.

In the Southwest Pass area of Louisiana's Gulf Coast, Shell will add a new refrigeration and absorption facility with initial capacity of 75 to 80 M.M.c.f. daily and ultimate capacity of about double that. It will set on concrete platforms in marshland and treat gas from Shell's Block 24 and Block 27 fields. Expected liquids recovery is 30,450 gal. per day of natural gasoline and 16,800 gal. per day of propane.

SHELL OIL CO. OF CANADA, LTD., is designing a plant with capacity of 88 M.M.c.f. daily at Crossfield, Alta. Recovery will be about 22,200 U. S. gal. per day of liquids when completed fall 1961.

At Waterton, Alta., a 110 M.M.c.f. daily plant is scheduled for completion by Shell of Canada in fall 1961. Products recovery would be 324,000 U. S. gal. per day, plus 1,100 long tons of sulfur per day.

SKELLY OIL CO. is building a new plant in Ford County, near Minneola, Kans. It will have capacity of 25 M.M.c.f. per day and expected recovery of 30,000 gal. per day of liquids. Contractor is Dresser Engineering Co., Tulsa. Refrigerated-absorption type. Completion set for 1961.



IMPORTANT CHANGES are being made at Sun Oil Co.'s big Laverne, Okla., gas-processing plant. Like many other companies in the U. S. and Canada, Sun is increasing its throughput by expanding this plant's capacity from 100 to 180 M.M.c.f. daily. Completion is set for this summer. This view shows existing glycol dehydration facilities, fuel gas scrubber, and regulator station. New facilities will be the refrigerated-absorption type.

STANDARD OIL CO. OF TEXAS will complete a new plant near Kermit in Winkler County, West Texas, April 15, 1961. Capacity will be 35 M.M.c.f. daily, with expected products recovery of 85,000 gal. per day. Type is refrigerated presaturated absorption.

SUN OIL CO. is expanding its Laverne plant in Harper County, Oklahoma, from 100 to 180 M.M.c.f. daily. Liquids recovery is expected to increase from present 111,800 gal. per day to 246,000. Completion of the refrigerated-absorption facility is expected mid-1961. Project includes modification for 75% propane recovery.

SUNRAY MID-CONTINENT OIL CO. is expanding its plant at Northwest Branch field in Acadia Parish, Louisiana, from 30 to 39 M.M.c.f. daily. Process type is absorption. Cost will be about $400,000. Completion is expected by July 1, 1961.

Sunray's Snyder plant in Scurry County, Texas, has been expanded from 78 to 81 M.M.c.f. daily. Holder Construction Co., Snyder, Tex., had contract. Completion was in February 1961.

TENNESSEE OIL REFINING CO. a division of Tennessee Gas Transmission Co., completed its new 75 M.M.c.f. daily plant at Palacios, Tex., in February 1961. Expected liquids recovery is 80,000 gal. per day. Contractor was O. L. Olsen Co., Inc., Houston. Process is refrigerated-absorption.

TEXACO INC. was to complete a new plant in South Kermit field, Winkler County, Texas, in March 1961. Capacity is 5.5 M.M.c.f. daily, with expected recovery of 7,300 gal. per day of propane, and 17,000 gal. per day of butanes plus. Process is refrigeration. Contractor is Kelley-Coppedge, Inc., Fort Worth.

TEXAS GULF PRODUCING CO. was scheduled to complete during first quarter 1961, an absorption unit of 65 M.M.c.f. daily capacity and a fractionator at Headlee, Ector County, Texas. Total cost is $3,367,000.

UNION OIL CO. OF CALIFORNIA plans an adsorption unit of 25 M.M.c.f. daily at Caillou Island, La., with expected recovery of 3,024 gal. per day of liquids. This is an offshore-type structure and will cost about $160,000.

Also in the planning stage for Union of California is an adsorption unit of 20 M.M.c.f. daily at Common Point, La. Recovery of 2,500 gal. per day is expected.

UNION PACIFIC RAILROAD plans a $3,000,000 gas-processing plant at Patrick Draw field, Sweetwater County, east of Rock Springs, Wyo. The project will help conserve natural gas which has been flared at the rate of 27 M.M.c.f. daily.

UNION TEXAS NATURAL GAS CORP. has started construction of its Sligo plant near Shreveport, La. Capacity will be about 150 M.M.c.f. daily with liquids recovery of about 125,000 gal. daily. Completion expected July 1, 1961.

WARREN PETROLEUM CORP. is enlarging its Mocane plant in Beaver County, Oklahoma, from present 150 to 200 M.M.c.f. daily capacity.

WARREN PETROLEUM CORP. and **ODESSA NATURAL GASOLINE CO.** are completing a plant in Azalea field, Midland County, Texas. Capacity is about 20 M.M.c.f. daily. Completion March 1961.

WESTERN LEASEHOLDS, LTD., plans a project at Wildcat Hills, Alta. (For details see listing for Canadian Fina.)

Reprints Available

Reprints of the Journal's 1961 survey, showing all existing and planned gas-processing facilities in the U. S. and Canada, are available at $2 per copy. The tables start on Page 106.

Place your orders with Reader Service Department, The Oil and Gas Journal, Box 1260, Tulsa, Okla.

How to design a V-belt drive

BY JOSEPH ZABA

POWER TRANSMISSION from the prime mover to speed reducer is accomplished in modern pumping units through V-belt drives.

In addition to other advantages inherent in all belt transmissions, V-belt drive permits high speed ratios (pitch diameter of large sheave divided by pitch diameter of small sheave), since the wedge action of the V-belt compensates for the small arc of contact, and the use of close-center drives. The following summarizes the information of interest to the user of the V-belt drives in beam-pumping installations.[1 2]

Design of drive. In selecting a V-belt drive for a given installation the concept of "design horsepower" is important. This factor is determined by multiplying horsepower requirements of the drive by a "service" factor. These factors depend on the type of service in which the drive is to be used and are available in manufacturers' literature for different types of industrial applications.

For a number of years there were some differences of opinion regarding the service factors to be used in beam-pumping service. A factor of 1.5 was sometimes used. The latest edition of API Standard 1B "API Specification for Oil Field V-Belting," Second Edition, March 1959, provides a formula for direct calculation of V-belt drive design horsepower in beam pumping:

$$HP_d = \frac{PT + SPM}{70{,}000} \qquad (1)$$

where

HP_d = horsepower
PT = peak torque, in.-lb.
SPM = strokes per minute

With design horsepower calculated, Fig. 46 may be used for selection of the V-belt. If the selected point falls close to the dividing line, both sections should be investigated. The more economical drive is then chosen.

There are several factors which must there are several factors which must be taken into account when considering the speed of the small sheave: (1) The desired pumping speed, (2) the available reduction ratio in the speed reducer, and (3) available or desirable speed of the prime mover. This point will be considered again later in the discussion of internal-combustion engines as prime movers of beam installations. Further, there is the question of belt speed, with speeds of from 4,000 to 5,000 ft. per minute considered as desirable. Finally, there is a limitation on the minimum pitch diameters for different sections of V-belts as recommended in API Standard 1B and shown in Table 10. If the sheaves with diameters less than these are used the horsepower rating of belts drops and the drive becomes less economical.

Desirable center distance of the drive is the sum of diameters of the driver and the driven sheave and should not be less than the diameter of the large sheave. Pitch lengths of belts can be calculated from the formula

$$d = 2C + 1.57\,(D + d) + (D - d)^2/4C \qquad (2)$$

where

d = pitch length of belts, in.
C = center distance, in.
D = pitch diameter of large sheave, in.
d = pitch diameter of small sheave, in.

The nearest commercially available length of belt is selected. The originally assumed center distance is then corrected for actual belt length by adding to C, if stock belt is longer, or by subtracting from C, if stock belt is shorter than the calculated belt, one-half the difference between the two lengths.

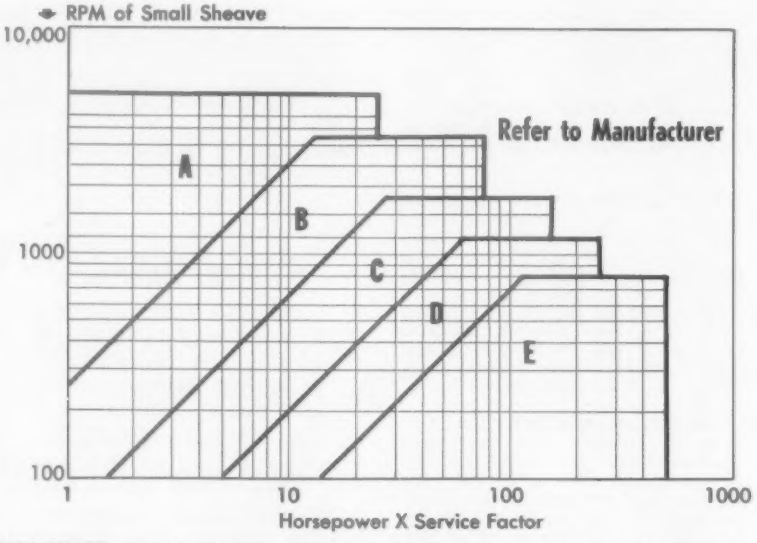
Number of belts is obtained by dividing design horsepower by horsepower rating per belt. These ratings and the factors by which they must be corrected require use of tables which are available in API Standard 1B and in the literature of manufacturers. The procedure is as follows:

1. For a belt of given type and section the ratings are furnished for different belt speeds and "equivalent"

TABLE 10—Minimum Recommended Pitch Diameter of Sheaves for V-belt Drives*

V-belt cross-section symbol	A	B	C	D	E
Minimum sheave pitch diameter, in.	3	5.4	9	13	21

*From Reference 2.



THIS CHART, reproduced from API Standard 1-B, can be used as a guide in selecting the correct V-belt cross-section when the speed of the small sheave and the horsepower requirements are known. Fig. 46.

diameter, which is obtained by multiplying pitch diameter of the small sheave by a factor in the appropriate table. These factors range from 1.00 to 1.14 for speed ratios from 1.000 to 2.949 and over.

2. Horsepower rating is given for arc of contact of 180°. To correct for actual arc, horsepower rating is multiplied by arc-of-contact correction factor. These factors are given in tables for different values of expression (D − d)/C the symbols being the same as in Formula 2. Factors range from 1.00 for arc of contact of 180° to 0.69 for arc of contact of 90°.

3. Horsepower rating is further corrected by the length correction factor given for different standard length designations and for different belt sections. This factor ranges from 0.81 for length designation 26 and V-belt section A to 1.19 for length designation 660 and V-belt section E.

4. Horsepower rating thus corrected divided into design horsepower gives the number of V-belts needed. If this number contains a fraction the next whole number is used.

Installation. Alignment of sheaves and parallelism of shafts is an essential requirement. During installation the center should be slackened so that the belts can be placed in the grooves by hand. The slack in each belt should be in the same side of the drive. The tension in the belts should be such that with the drive idle the belts appear snug and with the drive under full speed and load there is a slight slack in each belt on the slack side.

Maintenance. V-belts are capable of operating satisfactorily over a wide range of tensions. But it is sometimes necessary to measure the tension of the drive, procedure for which is given in API Standard 1B.

Grooves of the sheaves should be maintained in good state of repair and free of oil and foreign materials. Belt dressing should not be used with V-belts. In case of slippage both the belts and the grooves of the sheaves should be thoroughly cleaned. Low belt tension may also be the cause of slippage. Bearing difficulties may be caused by too-high tension. Guards should not rub the belts, and should be properly ventilated and drained.

Matched sets of the same make belt should be used. New and used belts should not be used in the same drive.

References

1. J. Zaba and W. T. Doherty: "Practical Petroleum Engineer's Handbook": Gulf Publishing Co., Fourth Edition 1956, p. 95.
2. API Standard 1B "API Specification for Oil Field Belting," Second Edition, March 1959.

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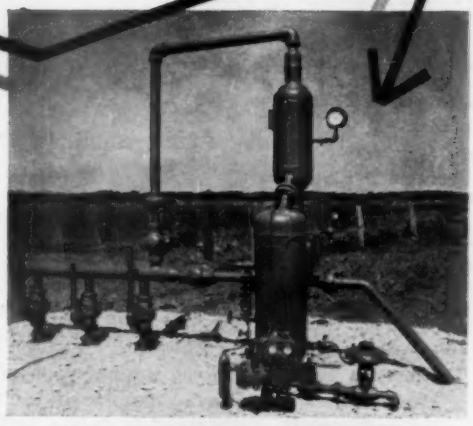

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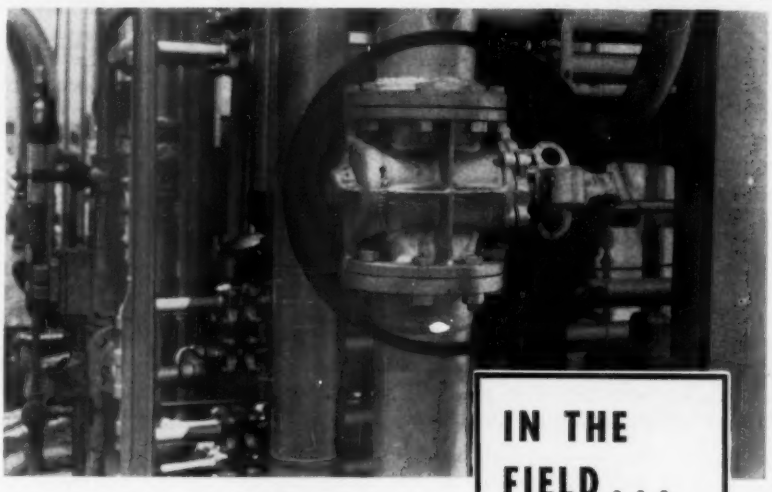

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WPRA panel tackles tough questions on Cracking Catalysts

Portion of transcript of WPRA session, El Dorado, Ark.

Panel Moderator **W. L. BANKS** Technical Director, WPRA Tulsa	**L. B. PARKS** Continental Oil Co. Ponca City, Okla.
D. P. HANDKE Standard Oil Co. (Ohio) Cleveland	**O. P. DOYLE** Ingram Oil & Refining Co. Chalmette, La.
R. M. BROWN Union Oil Co. of California Wilmington, Calif.	**F. W. KOPF** Atlantic Refining Co. Philadelphia
A. C. PATTERSON Esso Research & Engineering Co. Linden, N. J.	**T. J. OLESZKO** Aurora Gasoline Co. Detroit
J. A. BROOKS Standard Oil Company (Ind.) Whiting, Ind.	**J. A. GEARHART** American Petrofina Co. of Texas Mt. Pleasant, Tex.

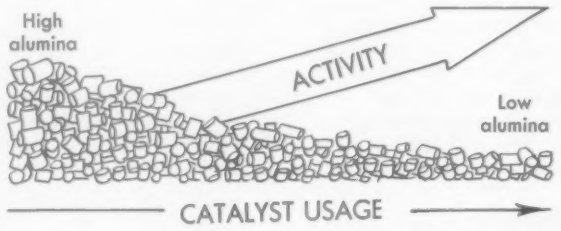
THESE MEN made up the WPRA panel who discussed refining problems.

BANKS: There have been a number of new cracking catalysts (Silica-magnesia, silica-alumina-magnesia, ruthenium-magnesia oxide addition to catalyst, lithium hydroxide on a siliceous catalyst, and metal chlorides) appear on the market during the past year. Does the panel wish to comment on this development?

PATTERSON: There were papers presented on silica-magnesia, and silica-magnesia-alumina combination at recent WPRA meetings. (WPRA Tech. 60-6 "New Cracking Catalysts for More Dollars per Barrel" DeBaun, R. M.; and WPRA Tech. 60-29 "Flexible Refinery Yields Through a New Fluid Cracking Catalyst" Ivey, F. E., Jr.) We understand that these things aren't available commercially, although large-scale tests are being made. Presumably the silica-magnesia catalyst has been improved in its regeneration characteristics. It occurs to me that perhaps this would be a solution to the question that came up before of increasing the yield of No. 2 fuel oil. Silica-magnesia, of course, makes a higher yield of gasoline and light cycle stock for a given conversion, than the usual silica-alumina catalyst does. Silica-magnesia produces a lower-octane gasoline, and this has been one of its major disadvantages other than its somewhat higher cost. But it turns out that this lower octane number is largely concentrated in the heavy naphtha part of the gasoline, so that if you undercut you get within one or two octane numbers of the same octane that you would get from silica-alumina catalyst. And you have a large yield of heavy naphtha of low octane number that you could include in No. 2 fuel oil.

M. S. PARK (Pure Oil Co., Nederland, Tex.): We have actually considered this problem and have looked into the possibilities, not so much from the standpoint of changing to silica-magnesia, but simply just changing to higher or lower alumina catalyst, depending on whether we need the C_4's at one particular time of the year or another. We observed, on our particular feed stock, a difference in the C_4 distribution and in the C_4 make at constant conversion using higher or lower alumina catalyst. We did find that the distribution, following the addition of higher or lower alumina, changed rather rapidly with makeup. In other words, if we started making up with the different catalyst, within a couple of weeks or so, we could see a decided change in product distribution. Actually, it seems that the fresh catalyst has an effect on product distribution considerably out of proportion to its concentration. They may be of some value to those of you who are considering a change in catalyst makeup.

CATALYST ACTIVITY



BANKS: To maintain the same catalyst activity what per cent reduction in usage could be obtained by switching to high alumina from low alumina catalyst?

DOYLE: Our data would indicate there wasn't any savings. We used the same amount of catalyst, received an increased activity number, but lost activity as indicated by yield structure.

PATTERSON: Our experience would say that in switching from low to high alumina catalyst you could reduce your catalyst addition rate by about 50%. You have to be careful in doing this, of course, from the standpoint of contamination. This answer applies only where contamination is not a problem.

PARKS: When we switched and eventually got all high alumina in the unit, our cat usage dropped about 35% and along with this drop in cat usage, activity went up from 29 to 31.5 wt. %.

BANKS: What is the current philosophy with regard to catalyst activity on throughput and yield structure?

BROWN: We're getting our conversion with temperatures. We have reactor temperatures up to the peg, so we let activity fall where it may. We have an extremely low catalyst make up. In our FCC it is about a ton a day, and we settle out at about 27 UOP wt. % activity. Our feed for that kind of operation might be about 23° or 24° API-gravity feed. If we had a projection of a higher-gravity feed, we would tend to raise our activity, but this is about as high a gravity feed as we ever run.

DOYLE: I've not been able to find where I can truly get any numbers to prove what activity level we would have to carry to economically be in the best position. But we do know that we appear to do best around 30 to 31 UOP wt. % activity. It costs us a tremendous catalyst loss through the stack to reach any higher number. We have operated as low as 26 UOP wt. %, but conversion and everything else at that time was poor, and there are other circumstances which we couldn't blame on the catalyst.

GEARHART: During initial operation of our TCC unit, before the catalyst approached equilibrium activity, we found that high catalyst activity definitely limited our throughput rate due to increased coke production.

BANKS: What is the apparent bulk density (ABD) for 100%-equilibrium high-alumina cracking catalyst? Is there any tendency for the ABD to continue to decrease with time even with 100% high alumina in the unit?

KOPF: Our number is 0.74 and the second part, no.

PATTERSON: In 1955 American Cynamid presented some data at a WPRA meeting (WPRA Tech. 55-9) in which they showed that the apparent bulk density of 25% alumina catalyst does change with time; it doesn't decrease with time as this question would imply, it increases. (See chart below.)

HARRY deLOOPER (Texas City Refining, Inc., Texas City): We have found that if catalyst activity drops to around 26 or 27 D + L we definitely see a change in the yield. We grant you can raise your catalyst or your reactor temperature to compensate for it. If you cannot get heat input by any other method than by raising the catalyst temperature in the regenerator above a known safe maximum temperature, then it is definitely detrimental having a low-activity catalyst. Therefore, if you operate under those conditions you never improve; you continually deactivate the catalyst. At 1,100° F. catalyst activity is not affected.

BANKS: In regard to TCC operations with reactor seal leg temperatures above 1,050° F., what are typical catalyst-addition rates and equilibrium-activity figures for natural-catalyst usage?

PARKS: At our Artesia, N. M. plant, when we increased the seal-leg temperature from 1,025° to 1,060° F. we experienced a simultaneous drop in cat A activity from 31.5 to 30 using a modified natural catalyst.

GEARHART: We don't operate on a steady diet of these high catalyst temperatures, but we have operated in excess of 1,050° F. on a blocked-out operation running the light cycle back through the TCC unit and cracking it alone. In those instances we have operated with temperatures as high as 1,065° F. We have not noted any increase in catalyst losses or any ill effects on activity as a result. Catalyst activity was about 29-30 and the addition rate around superheated seal steam (980° F.).

R. J. MADDOX (Texas City Refining, Inc., Texas City): I would like to ask Lou (Parks) why the activity drops over just that small a temperature range.

PARKS: At the time we thought it was high-temperature steam deactivation. However, there may have been other factors contributing to the activity decline.

MADDOX: Was it critical to 10° F.?

PARKS: No, this was over the range from 1,025° up to 1,060° F. Our normal operation was 1,025° F., and for awhile we operated as high as 1,060° F.

deLOOPER: Are you talking about a bucket-elevator or air-lift TCC unit?

PARKS: This is an air lift.

deLOOPER: I was wondering why your catalyst deactivated at such low temperatures. There may be some other reason, possibly high temperatures in the kiln, sodium poisoning, or metals contamination. In

PHYSICAL PROPERTIES OF CATALYSTS AGED UNDER REACTOR-REGENERATION CONDITIONS

	25% Alumina Catalyst					13% Alumina Catalyst				
Cycles in unit	0	120	240	360	480	0	120	240	360	480
W.H.S.V. for 55% conversion	7.7	5.6	5.5	4.8	4.5	6.0	4.5	4.4	3.2	3.1
Surface area, M^2/g.	534	334	298	279	270	605	331	316	306	288
Pore volume, cc/g	0.84	0.72	0.66	0.65	0.61	0.75	0.53	0.53	0.53	0.47
Pore diameter, angstroms	63	86	89	98	91	50	64	67	70	65
ABD, g./cc.	0.39	0.47	0.49	0.49	0.54	0.46	0.57	0.56	0.56	0.58
Activity/surface area	0.22	0.22	0.24	0.23	0.23	0.19	0.20	0.19	0.19	0.19

our Houdriflow cat cracker we run much higher than 1,050° F. We operate between 1,100° and 1,140° F. seal-leg temperature. We do not have catalyst deactivation at that temperature.

In fact, we have run higher mainly because we need that high a temperature to maintain the reactor temperature desired. This, of course, varies with the type of catalyst you're using—if the catalyst is Clay, Grade 62, it does deactivate at lower temperature than the 110 or the Kaolin catalyst, but for years we have been operating higher than 1,050° F.

BANKS: Has any fluid-unit reactor been operated without a grid plate, and if so, with what success?

DOYLE: We've not intentionally operated without a reactor grid, but we have found the grid eroded to the point where it is not fully effective. We did not see a great deal of difference after we repaired it.

PATTERSON: Our experience has been somewhat different. We have not intentionally operated without a grid in the reactor, but here the resemblance ceases. We have encountered very considerable increases in carbon yield at a given conversion when the grid has eroded or when any of the plates has become displaced. We also intentionally operated a regenerator without a grid in it. This is the way the accursed thing was designed. Not, let me say, by Esso engineers, but by another outfit. This unit vibrated so badly that we were afraid it was going to vibrate itself right off the foundation before we got it shut down. And in the meantime, the regeneration efficiency was very poor, and our air utilization was very bad indeed.

BANKS: What methods or techniques are used for determining amount of carbon laydown on cracking catalyst? How successful?

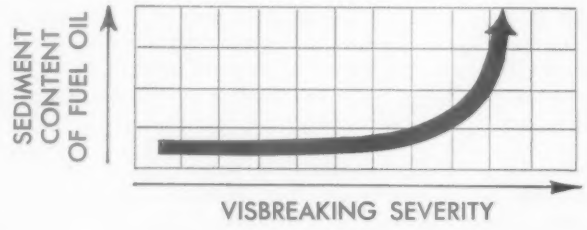
PATTERSON: I'm sure that the catalyst suppliers have manuals that describe the methods for determining the amount of carbon on cracking catalysts, if that is what the question means. I think that simply by getting in touch with these organizations you can get a more authoritative answer than I can give you.

R. L. FLANDERS (California Research Corp., Richmond, Calif.): We have tried a reflectance type of measurement for carbon on catalyst in our laboratory and found it useful. We have now installed it in all of our commercial-unit control houses. As long as the plant catalyst is not too high in carbon content, changes in carbon content can be quickly determined. Our particular equipment has three filters which permit us to operate over a range of 0.05 to 0.9% carbon on regenerated catalyst.

BROOKS: Could you give us a little more information on what this thing did?

FLANDERS: The basic principle of the equipment is reflectance. A small glass holder is filled with catalyst on to which a light beam is directed through the filter and reflectance is measured. The equipment is described in an ACS paper by Ramser and Hamlen, "Analytical Methods Division of Petroleum Chemistry," Chicago meeting, September 1953. The equipment is called "Lumetron Photoelectric Colorimeter" and is available from Photovolt Corp., 95 Madison Avenue, New York.

FEED PREPARATION



BANKS: Discuss factors affecting the optimum severity for visbreaking operations which recover FCCU feed?

KOPF: There are many sides to this question. There is a degradation of gas-oil quality going through the visbreaker.

So the first point would be to run as short a resid as possible through the visbreaker, taking out maximum virgin gas oil ahead of time. On the other hand, once you have a given feed for the visbreaker we feel that as you increase the severity on the visbreaker, the quality of the visbroken gas oil does not suffer too much further. In other words, you can up the severity without worsening the quality too much further.

Another factor is that separation is very important. Separation is important from the standpoint of minimizing metals carried over into the gas oil. Also the Conradson carbon, which we feel goes directly to coke in the cat cracker. Then of course, the over-all economics would depend on the yields and values that you use for products and the run length.

We would think that taking these factors into consideration, the severity that can be obtained in a run of about 4 weeks would be somewhere near the optimum point if short shutdowns can be achieved. I know some people consider the quality of the residue may suffer if you run too severely. Some articles have been published on that score.

PATTERSON: The only thing I can add is to confirm that we do worry about the quality of sediment of the fuel oil you get from visbreaking. Sediment content goes up rather slowly as you increase operating severity at first, but on most stocks we have dealt with, you eventually come to a point where a small increase in severity will cause the sediment content of the fuel oil

produced to skyrocket. We generally find that this is the limit of our operating severity.

BANKS: For phenol or furfural extraction of cat cycle stock what percentage increase in capacity of cat cracker may be expected?

PATTERSON: I do not have a before-and-after comparison that would say what percentage increase in capacity you get by extracting the cycle stock. We have practiced this, though, and the reason I don't have a clean-cut comparison is that the raffinate was cracked along with a bunch of other stuff so we couldn't separate the effect. How effective this will be, of course, depends on how aromatic the cycle stock was to start with. The purpose of extraction is to remove the aromatics and thereby reduce coke yield. In one particular instance we extracted a heavy cat cycle stock with the following results:

	Vol. %	°API	S.s.U. at 210° F.	Aromatics-wt. %	Diesel index
Feed	100	19	41.8	46.4	30
Raffinate	58	35.5	39.1	11.2	78

RAY DUDLEY (Bay Petroleum Corp., Chalmette, La.): We made a paper study of two extraction cases. For one in which we were limited by carbon burning in the regenerator, we calculated a 15% increase in capacity. In the other case where reactor velocity was our limitation, we calculated an 8% increase in capacity. In the base case here, operating at about a 1.6 combined feed ratio.

FLANDERS: In a fluid pilot-plant evaluation of furfural refining, a 95% raffinate of a California gas oil was compared to raw oil. At the same coke make we show 50% conversion of the raw oil and 58% conversion of furfural raffinate. A similar shift was indicated in gas capacity. The gas make at 50% conversion of whole oil was equal to the gas make from the 95% raffinate at 53.5% conversion.

KOPF: Just to add a capacity number, we have operated a plant unit and obtained a 10% cat cracker capacity increase running at extinction.

BANKS: Has anyone tried propane deasphalting of residues as means of increasing cat cracker feed stock? How much does this decrease production of No. 6 fuel?

PATTERSON: The decrease in No. 6 fuel obviously depends on where you start. In some of our refineries we have been able to justify deasphalting vacuum bottoms to get additional cat cracking feed.

PARKS: I have some data from our Billings refinery which runs a heavy Wyoming sour crude. We charge atmospheric bottoms to a propane deasphalter. When pitch from the deasphalter is cut back to a No. 6 vis. we make about 20% No. 6 yield on crude. If we did not charge reduced crude to the deasphalter, but merely cut it to No. 6 vis. specifications, we would yield about 40% fuel oil on crude. I might add that we increase cat cracker charge from about 18% on crude to 39% with the deasphalter.

KOPF: My answer would check that pretty well. On the first part of that question, we would say a 50% reduction in No. 6 fuel. However, if you compare it with other alternates, we would find that vacuum flash visbreaking would reduce fuel yield about 10% more than propane deasphalting on most feed stocks.

ROBERT PONDER (Clark Oil & Refining Corp., Blue Island, Ill.): I'd like to ask, in the case of propane deasphalting, what happens to the metals? Do they go in the cat charge, or do they stay in the bottoms?

PATTERSON: Most of the metals go into the bottoms. In order to do a selective job of this you do have to have a fair number of stages and use a fairly high treat. Our experience would say that you need at least five stages to do a selective job of discarding the metals with the bottoms.

L. R. REINKEMEYER (Anderson-Prichard Oil Corp., Arkansas City, Kans.): We practice propane deasphalting on the vacuum-tower bottoms, and in most cases it will certainly increase gas-oil production for cat charge. Everyone operating vacuum towers is concerned with making clean gas oil. In many cases it is necessary to make a slop-wax cut off the vacuum tower to make a suitable low-carbon-residue gas oil for the cat cracker. It is possible to eliminate slop wax with propane deasphalting. In our case, we made a 200 bbl. per day yield of slop wax that had to be downgraded into No. 6 fuel or thermal cracker charge or some such thing. With propane extraction, cat charge was both improved in quality and quantity.

ED MEAUX (Cities Service Refining Corp., Lake Charles, La.): We are propane deasphalting vacuum bottoms, which is about 12°-15° API material. We get about 50-60% gas-oil yield from this deasphalting operation. We think it is pretty good cat feed. The asphalt is visbroken for No. 6 fuel, and we think that eliminating gas oil from visbreaker feed increases our run length.

BANKS: What are the justifications and results to be expected from extraction units on cat heavy-cycle stocks for catalyst cracking feed?

HANDKE: We feel that, if you already have extraction facilities, in all probability it is going to be attractive for you to do it. But whether or not you can justify facilities just for this purpose gets into a lot of ramifications. We do feel that, if you've got the facilities and have the capacity in them, that it is probably attractive to use on this particular stock.

KOPF: Solvent extraction produces lower gas and coke yields on the cat cracking unit. Our experience was a 10% increase in capacity at extinction. We ran a solvent extraction unit in conjunction with a cat cracker. As conditions changed there came a time when we couldn't afford to run it any more and it was shut down. We feel other means, usually available to obtain capacity, might be more economical.

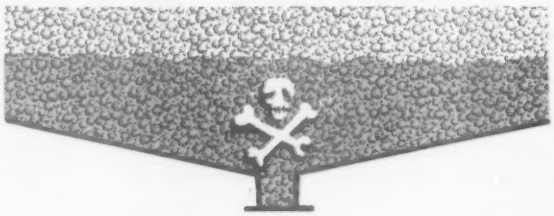
R. A. LUSH (DX Sunray Oil Co., Tulsa): What are other refiners doing with the extracts from extraction units operating on catalytic cycle oils?

KOPF: Our extract was sold for carbon-black manufacture.

L. P. EVANS (Socony Mobil Oil Co., Paulsboro, N. J.): For refineries that have lube-oil processing facilities with solvent extraction and also have cat cracking, a good trick is to use the extract phase from the lube-oil extraction unit to extract the cat feed stock. This extract phase contains some paraffinic constituents which made good cat cracking stock, and there is an exchange of paraffinic and naphthenic materials between the phases. So you actually end up by gaining valuable feed stock from the lube oil extract. At the same time you extract from the gas-oil charge the naphthenic material you want to get rid of. In fact, you can recover more than 100% of the raw cat cracker feed as good paraffinic cracking stock. The only equipment requirements are two simple mixing and settling stages plus an extra raffinate stripping tower. The scheme works with either furfural or phenol-extraction. (This practice is covered by U. S. Patent 2748055, assigned to Socony Mobil Oil Co.)

W. E. McFATTER (Cities Service Refining Corp., Lake Charles, La.): I might add that in considering the justification of extraction facilities you might also bear in mind the liquid volume loss that occurs when you crack aromatics. We've cracked 3.0° API gravity decanted oils with 100% weight recovery. We've got yields of about 82% C_4-end point. And that's significant in your over-all economics.

CATALYST POISONS



Metals . . .

BANKS: Has any work been done on a method of rendering contaminating metals inert before introducing them into the catalytic cracking unit?

L. P. EVANS: Our experience with the TCC process shows that nickel is about five times as active as vanadium for metal poisoning.

Secondly, several of our TCC units have in previous years experienced periods of high metals carryover from the feed-prep system into the TCC. This resulted from displacement or disruption of demister blankets in the vacuum tower, which permitted metals carryover by entrainment into the cat cracker feed. This has been remedied by shutting down the vacuum tower and correcting the problem at that point.

Finally, in regard to the general question of eliminating metals, there is a possibility with the TCC process of exercising some selective removal of metals, even though they do get into the reactor. This is related to the type of catalyst used. The catalyst is a bead material whose structure is such that it acts as a sieve with the result that about 95% of the metals actually deposit in a very thin film on the surface of the bead. Normally enough of this metal is ground off the surface by natural attrition in the unit to maintain metal concentration at a safe level.

Thus, analysis of the fines discharged from the unit shows a very high concentration of metals; many times the concentration of the metals on the main catalyst circulating in the system. Where metals input is excessively high, they can still be prevented from building up to harmful levels on the catalyst merely by adjusting the airlift to provide extra attrition and selective metals rejection without excessive catalyst loss.

DOYLE: We had some sodium poisoning that brought us up from 0.04 to 0.4% sodium, but unfortunately as far as seeing its effect, we also had some vanadium and nickel. The apparent result of having this amount of sodium increase was about 1% loss in gasoline.

We didn't notice any sintering, the sintering number didn't go above three at any time during this period. Nickel was up to around 300 p.p.m., vanadium was in the 1,800-p.p.m. level, iron was in the 0.4% range and sodium increased from 0.04 to 0.4%.

There was a poisoning effect, but I don't know whether it was due to the sodium or just due to iron, nickel, and vanadium contents. We received this poisoning by taking a bottoms cut from a condensates fractionator directly to our FCCU. We eliminated it by taking those same bottoms into a vacuum unit and after removing the metals the sodium dropped back to 0.06-0.02% level. Iron stayed high, nickel dropped to less than 100 p.p.m. and vanadium dropped to 200 p.p.m

This only represented about 1% difference in gasoline. I was rather surprised at the number. I would have thought it would be higher looking at the literature. We see a lot bigger changes made from crude selection or crude sources.

MADDOX: I'd like to ask Paul Doyle what the activity was before and during this metal poisoning?

DOYLE: This is Davison's D + L. Before it was 29 and afterwards it was 30. The CO_2/CO dropped from 1.2 down to 1.1. I didn't see any other significant changes.

MADDOX: We have just gone through a little sodium

poisoning ourselves, and when our activity was down as low as 24 or 25, we had a sodium content of about 0.3% on catalyst. Our activity is back up to the 30 level (this is Sun Oil's Cat A activity) and sodium has dropped back to about 0.2%. On our equilibrium catalyst, the sodium content should eventually line out at considerably less than 0.1%. So even though sodium content is still rather high, we have apparently got activity up. I was wondering if anyone had any comments on acidic function here. We are pretty sure this was sodium hydroxide poisoning. We know where the sodium came from and there may be some sodium left in the oxide state, but is sodium oxide a poison? Or is sodium hydroxide a poison where the oxide isn't?

DOYLE: I can't answer you, but I suspect that often the sodium may come in with the spray water and show as sodium-number increase, and the poisoning effect is really due to some other metal that's on the catalyst that's being activated by an acidic condition induced by the spray water.

FLANDERS: I have some information which may help here. At the suggestion of George Masologites, we set up a fixed-bed fluid test introducing sodium by a drip technique on top of the bed. We ran tests using sodium hydroxide, sodium naphthenate, and sodium sulfonate. We found these sodium compounds to be interchangeable and that the effects were in proportion to the sodium deposited on the catalyst. The numbers developed by this test were as follows: The loss in conversion in a fixed-bed activity test (Phillips method) was 0.75% conversion per 100 p.p.m. sodium added. We show, for example, a drop from 30.5 activity to 24.8 activity with 700 p.p.m. sodium added to the catalyst. It didn't make any difference whether sodium naphthenate, sodium sulfonate, or sodium hydroxide was used. We concluded that the sodium ion, once it goes through the first regeneration step, is chemically combined with the catalyst.

G. P. MASOLOGITES (Atlantic Refining Co., Philadelphia): Some years ago we found that sodium is not a poison in itself as far as making coke is concerned. It will decrease cracking activity. You end up making more coke simply because you have less-clean acid sites to give you clean cracking, so it is a secondary effect. I am very happy that Bob Flanders' work turned out as it did because we have always considered sodium a very mobile cation as far as catalyst are concerned. Once it gets on the catalyst it will distribute very readily.

I recall on this deactivation of contaminants an unfortunate incident we had in some pilot-plant operations about 10 or 12 years ago. We sampled some naphthenic gas oil in galvanized drums and in the course of about 2 days coke yield in the pilot plant tripled. We thereafter, charged a clean gas oil and we found rapid decline in coke make. As I recall, in about 3 days it had declined to less than 50% of what it was at its maximum, which would indicate a rapid deactivation of this particular contaminant.

DOYLE: Where we lost 1% of gasoline with this questionable sodium poisoning, we didn't lose any conversion. The conversion number stayed the same, and what we lost was gasoline and made coke and gas out of it.

BANKS: Several formulas are in use in arriving at the contaminating effect of one metal versus another. What are the effects of metal that has aged in the unit versus metals freshly entering the system?

PATTERSON: In introducing my comments on this question, I would like to recite a little verse that I read recently:

"In controversial matters,
my perception's rather fine.
I always see both points of view,
the one that's wrong,
and mine."

This is a controversial question as far as the alleged experts in Jersey are concerned. There is considerably less than complete unanimity on whether contaminants do deactivate. From one study of commercial unit data, some of us have been able to convince ourselves that the metals deactivate at the rate of about 15% a day. You recognize there is no universal figure here and it will depend on the operating conditions—and we certainly haven't tied down the effect of the different operating conditions. This number is just to give you a rough idea of how fast we think they deactivate. We also can't say whether nickel and vanadium and iron all deactivate at the same rate. We just don't know. We would suppose they would deactivate at different rates, but I have no data to support this assumption.

L. G. BRANNIN (Cities Service Oil Co., Ponca City, Okla.): We had severe metal contamination in our cat cracker about a year ago. Nickel and vanadium content on the catalyst had gotten up to 300 or 400 p.p.m., and we were losing 6-8% conversion on the unit. We corrected this problem by revamping our crude unit. A month after we had good-quality feed going into the unit it had recovered, to all appearances, from this metal contamination. While the analysis of the catalyst still showed 300 p.p.m. nickel and vanadium present, there was no evidence in the unit operation that it was causing any trouble. Apparently it had completely deactivated in this short period. Metal content has since dropped to 50 or 75 p.p.m., and there has been no change in the unit's operation.

FLANDERS: I wish to make two comments on metals:

First, it has been our experience that the metals concentration measured by emission spectrograph or wet-chemical methods is not necessarily related to hydrogen make. We assume that the metals effect is proportional to the available metal surface. This may or may not be indicated by a chemical technique.

The second observation is that the crude source also contributed to the metals effect. For example, one of our plants recently brought onstream was designed to charge a heavy gas oil not to exceed 0.3 p.p.m. nickel. Based on previous experience, this would be a satisfactory metals concentration. When that plant came on stream, it was observed that 0.3 p.p.m. nickel was too high. We were running 50 to 55% hydrogen in the absorber tail gas. We had to

drop the nickel concentration to 0.1 p.p.m. (which gave us an analytical problem) to reduce the hydrogen make to a reasonable level. This indicated to us that one plant can operate satisfactorily at 0.3 p.p.m. nickel whereas another had to operate at 0.1. The conclusion we reached is that the crude source must have something to do with the metal disperson on the catalyst.

MASOLOGITES: I might refer the audience to a paper by Drs. Connor and Leom on "Fluid Cracking Catalyst Contamination"—Ind. & Eng'g. Chem. Vol. 49 No. 2, February 1957, pp. 276-282. In this work we looked at nickel, vanadium, chrome and iron, etc., and generally speaking we found nickel to be four times as effective a contaminant as iron, and vanadium 0.8 as effective as iron. To expand on what Bob Flanders was talking about, work was done some years ago where I recall we did use different molecular-weight naphthanates in depositing these contaminants in a fixed fluidized bed. The molecular weight of the contaminant definitely affected the coke-producing properties, whether using a 200 or 400 molecular-weight metal naphthanate.

PATTERSON: I might also refer the audience to the symposium on catalytic cracking and catalysts that was presented at the American Chemical Society Meeting in September 1960. One of the papers was by Gulf. I won't attempt to review the paper, except to say that they found vanadium, at least, does not deactivate with age. (Donaldson, R. E., Rice, T., and Murphy, J. R., "Metals Poisoning of Cracking Catalyst Under Typical Refining Conditions.")

Sulfur compounds . . .

H. A. McCANDLESS (American Oil Co., El Dorado, Ark.): Is carbonyl sulfide removed by the conventional treating process for H_2S and mercaptan removal?

KOPF: It is not removed by a simple caustic wash. As I remember, someone from Shell, Frolor, as a matter of fact, had a patent on removing carbonyl sulfide with some modification of caustic wash or other agent. In our case the carbonyl sulfide showed up as sulfur on the alumina dryers which followed a caustic and water wash. We had to modify our regeneration procedure, I believe, by lowering the pressure to get the sulfur off, so it would not contaminate LPG going through the drying system.

McCANDLES: There has been some thought that when you run into sour poly gasoline or propane, for example, off a cat poly unit, this might be the source of trouble. This has always been a supposition, and I just wondered if it could be the result of a treating problem.

BROWN: We find in our FCC-make gas about 30 p.p.m. carbonyl sulfide, in our TCC-make gas, about 20 p.p.m., and in our catalytic propane-propylene, about 150 p.p.m. As I recall, going back a few years, it was carbonyl sulfide which was the bad actor in MEA systems, and I believe this was the thing that drove many of us to DEA some years ago. Recently we have converted our DEA systems to MEA, now that the MEA can be reclaimed.

MADDOX: We have suspected that carbonyl sulfide also came through our 20 Baume caustic treater which was treating cat propylene-propane. Is this analysis of carbonyl sulfide one of the standard analyses? You mentioned 30 p.p.m. Is this easily detectable by a classical technique?

W. J. BARAL (Union Oil Co. of California, Brea, Calif.): Analysis of carbonyl sulfide is done by a special technique on the mass spectrometer during routine gas analysis. They take a special look at the pattern. Once you learn the technique it is relatively easy to analyze, but it must be looked for, specifically.

G. D. BORTHICK (Bay Petroleum Co., Denver): Some years ago when I was with Utah Oil in Salt Lake, we ran into the problem of carbonyl-sulfide corrosion in our propane. At that time there had been considerable work done by Skelly and Phillips on solving the problem. Based on work done by Indiana Research, and published work, we solved our problem by adding a flake caustic scrubber down stream of our calcium-chloride dryers. This solid caustic scrubber was cleaner and recharged after approximately 1 million gallons of propane were treated. Brooks may be able to find some of the details of this work in the Chicago-Indiana files.

BROOKS: In response to Borthick's suggestion, I have looked up the procedure for carbonyl sulfide removal from LPG used at Utah Oil Refining Co. at Salt Lake and find that it is substantially as he reported. In addition, I find that a comprehensive article on "The Chemistry of Carbonyl Sulfide," by R. J. Ferm was published in Chemical Review, Vol. 57, No. 4, August 1957.

E. M. BLUE (California Research Corp., Richmond, Calif.): California Research Corp. has a patented process for removing carbonyl sulfide and is making it available for licensing.

BANKS: What are the symptoms of sulfur poisoning in catalytic cracking and what can be done about it?

BROOKS: According to our information, the obvious symptoms of sulfur poisoning in cat cracking is about the same as metal poisoning; that is, more hydrogen and more coke production. This poisoning on natural catalyst is greatly alleviated by steaming the catalyst in the hoppers or stand pipes ahead of contact with the oil. Our information says that such presteaming prevents the sulfur from activating the iron within the clay structure of the catalyst and thus causes poor yields.

PARKER: I believe that all catalyst manufacturers have different products which can be used for high-sulfur and low-sulfur feed. At least I know of one, and I assume the competition is the same. So it may be that you may want to change the type of catalyst.

Nitrogen compounds . . .

BANKS: Has anything been found to mask or neutralize the inhibiting effect of nitrogen compounds?

PATTERSON: We have had no direct experience on this, but we have heard of another company that has high nitrogen feed stocks who finds that it can at least reduce the problem by running at higher reactor temperatures, in the order of 900° or 1,000° F.

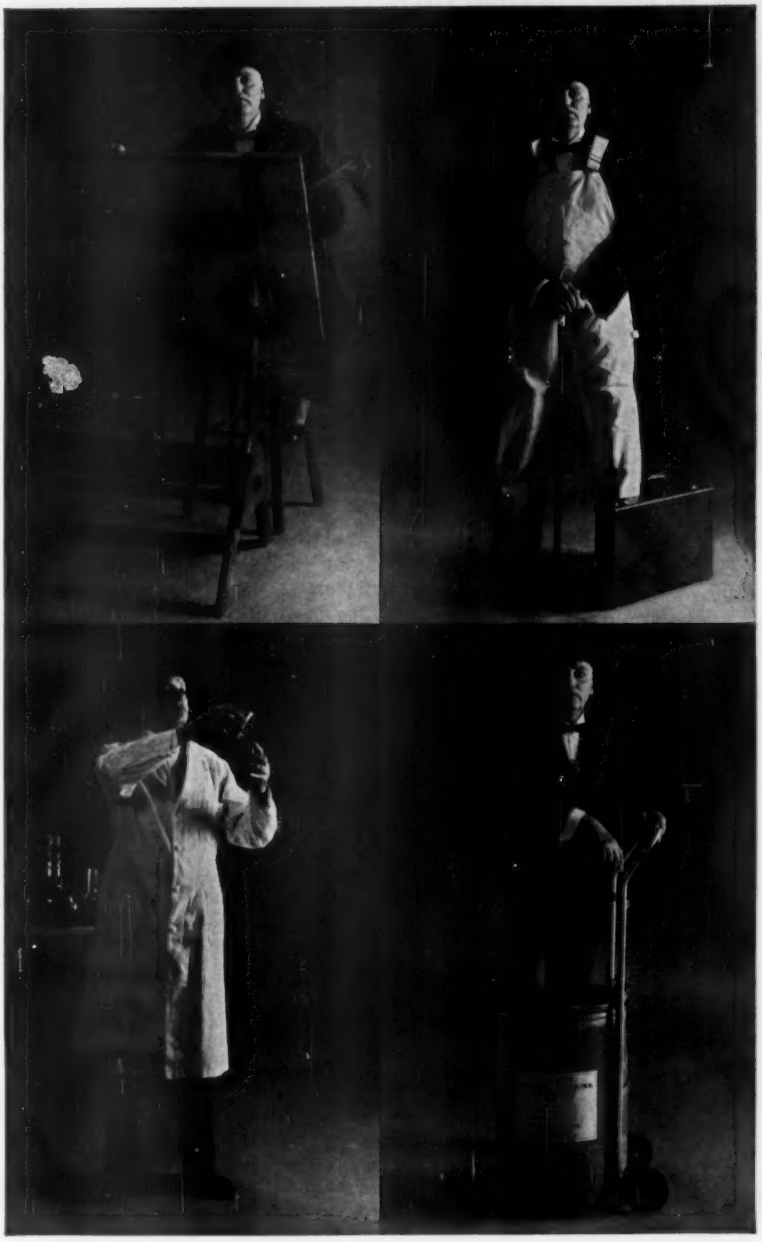
BROWN: Regarding high reactor temperature, we're doing just what was mentioned. We are running about a 980° to 990° F. reactor temperature. Our nitrogen runs about 3,000 p.p.m., and we feel that these high temperatures are the right direction for us to go.

KOPF: The nitrogen contents that have been talked about so far have been pretty high numbers. Does anyone have any experience with nitrogen of 0.1%? Do they find that that's a serious factor?

PATTERSON: There is no question in our minds at all but that 0.1% is rough. It isn't as bad as these higher quantities that are mentioned, but I think it works like a lot of other inhibitors. The first little bit is more effective in poisoning the catalyst than the next equal increment.

BANKS: Which type of nitrogen compounds have the most inhibiting effect?

PATTERSON: The information we have is that basic nitrogen compounds are worse than the nonbasic ones. Quinolines, pyridine, and ring compounds are the bad actors; amines apparently are not so bad.



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HOW TO REDUCE DRILLING COSTS: PART 10

How to use the impact method in drilling-rig hydraulics

BY PRESTON L. MOORE
University of Oklahoma

THERE'S a lot of controversy and confusion in the drilling industry about the best basis for rig hydraulics. Some base their system on **bit hydraulic horsepower.** Others prefer the **hydraulic impact** method.

Is there a difference in the two? Mathematically, yes! In theory, yes!

Those who support the bit-horsepower system believe that the efficiency of removing cuttings from below the bit depends on the **work** performed by the fluid. The hydraulic-impact theory does not consider this work directly. Instead, those who support the hydraulic-impact method believe that removal of cuttings depends on the **force** with which the fluid hits the bottom of hole.

Which is best? Let the reader understand both methods and then make his own selection. If properly used, **both** may improve drilling rates.

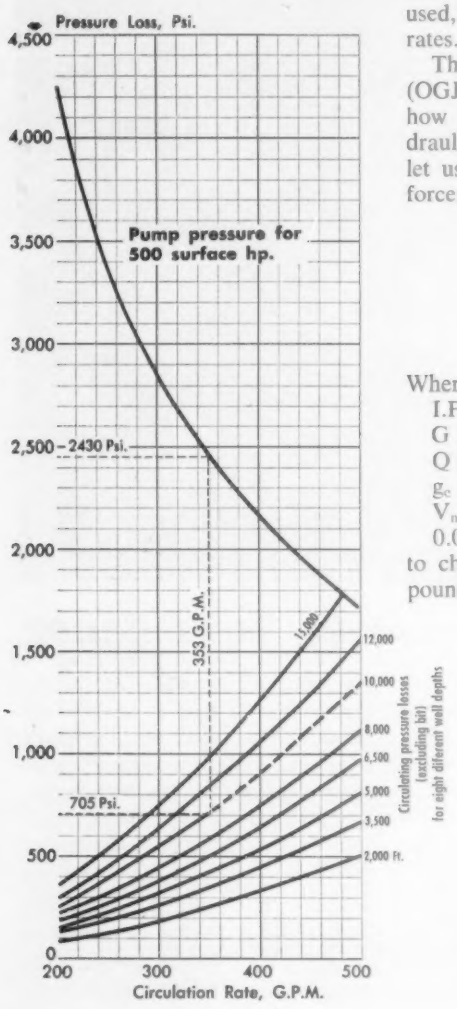
The last article of this series (OGJ, Jan. 23, 1961, p. 77) showed how to calculate with the bit-hydraulic-horsepower method. Now, let us turn to the hydraulic-impact force; it is defined in Equation 1:

$$\text{I.F.} = \frac{G\,Q\,V_n}{60\,g_c}$$

$$= 0.000516\,G\,Q\,V_n \qquad (1)$$

Where:

I.F. is hydraulic impact force
G is mud density, lb./gal.
Q is volume rate of flow, g.p.m.
$g_c = 32.17$ ft./sec.^{2}
V_n is nozzle velocity, ft./sec.
0.000516 is a conversion constant to change minutes to seconds and pounds mass to pounds force



CIRCULATION RATE as function of pressure, for 500 hp. and circulation system defined in Example 1. Fig. 1.

As we did with hydraulic horsepower, we can write an equation for drilling rate versus impact force:

$$\text{Drilling rate} = K^1 A\,V_n \qquad (2)$$

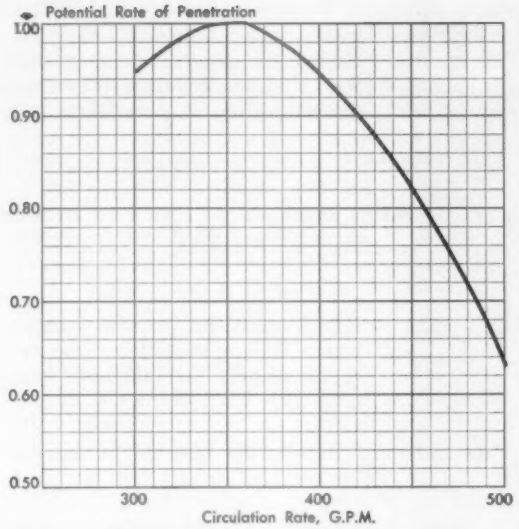
Where:

A is effective nozzle area
K^1 is a proportionality constant including mud weight and the conversion constant in Equation 1

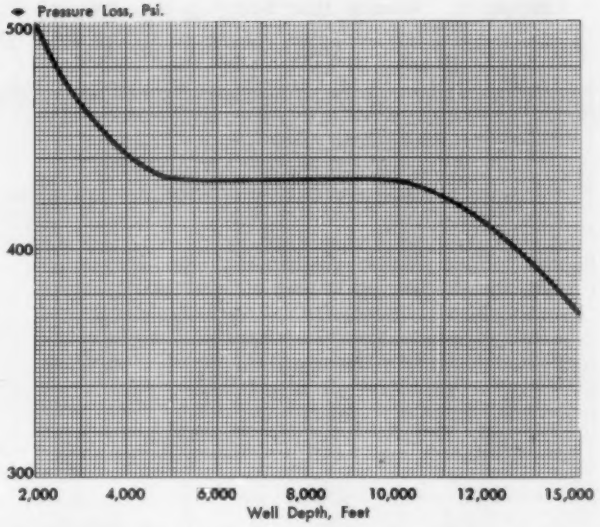
The impact force we calculate from Equation 1 depends directly on mud weight; the higher the weight, the greater the impact. However, mud weight is not something we can increase at will. For that reason, we can consider it constant for any given system when we are determining optimum impact or optimum drilling rate from Equation 2.

In an earlier article,[1] we gave an equation for optimum impact; this equation uses the condition that pressure loss is a function of the square of the volume rate of flow. The article showed that if surface pressure is constant and pressure is not limited within reason, impact is optimum when 75% of the horsepower or available pressure is used at the bit. Let us take the case where we use bit horsepower exclusively and when there is no limit on pressure. Bit horsepower is maximum when the flow rate approaches zero or when bit horsepower approaches surface horsepower.

How to find optimum. To be more exact, let us repeat the development of optimum impact. We shall use the condition that pressure is proportional to the 1.84 power of Q. (Last article in this series points out that pressure loss in turbulence is proportional to $Q^{1.84}$.) Equation 2 takes another form when we recognize that V_n is proportional to flow rate and in-



RELATIVE DRILLING RATE as function of circulation rate. Optimum circulation is 355 g.p.m. for this example. Fig. 2.



OPTIMUM CIRCULATION RATE as function of well depth. System defined in Example 1. Surface pressure is limited to 2,000 psi. Fig. 3.

versely proportional to the square of the effective nozzle diameter:

$$\text{Drilling rate} = \frac{KQ^2}{D_n^2} \quad (3)$$

Where:

K is a new proportionality constant containing K^1

D_n is nozzle diameter

Total horsepower at the surface is:

$$Hp_s = \frac{P_s Q}{1{,}714} \quad (4)$$

This horsepower is distributed:

$$Hp_s = \frac{P_c Q}{1{,}714/1} + \frac{P_B Q}{1{,}714/2} \quad (5)$$

where the first term is the horsepower used in circulating and the second is that developed at the bit. Now, remember that P_c is proportional to $Q^{1.84}$ and that P_B is proportional to $Q^{1.84}$ and inversely proportional to Dn^4. We can rewrite Equation 5:

$$Hp_s = G\,Q^{2.84} + \frac{E\,Q^{2.84}}{D_n^4} \quad (6)$$

Where:

G and E are proportionality constants.

Solving for D_n^2 and substituting in Equation 3, the equation for drilling rate may be stated as:

$$\text{Drilling rate} = K\left(\frac{Q^{1.16}\,Hp_s - G\,Q^4}{E}\right)^{1/2} \quad (7)$$

Constant horsepower case. Let us consider surface horsepower constant. Pressure and flow rate may vary, but the product of the two must remain constant. Equation 7 is an expression for drilling rate in terms of flow rate only.

Maximizing drilling rate as a function of circulating rate:

$$\frac{dR}{dQ} = \frac{K}{2}\left(\frac{Q^{1.16}\,Hp_s - G\,Q^4}{E}\right)^{1/2} \times (1.16\,Q^{-.16}\,Hp_s - 4\,G\,Q^3) = 0$$

or

$$Hp_s = 3.45\,G\,Q^{2.84} = 3.45\,\frac{P_c Q}{1{,}714}$$

or

$$\frac{P_c Q}{1{,}714} = 0.29\,Hp_s \text{ or}$$

$$P_c = 0.29\,P_s \quad (8)$$

What, then, does Equation 8 mean for any given surface horsepower? It means that 29% of the surface horsepower should be used in the circulating system and 71% at the bit to obtain maximum impact. Note that in this case there is no limit on surface pressure.

What happens if surface pressure is limited? Go back to Equation 7. Substitute P_sQ for Hp_s and the equation for drilling rate may be written:

$$\text{Drilling rate} = K\left(\frac{Q^{2.16}\,P_s - G\,Q^4}{E}\right)^{1/2} \quad (9)$$

Again maximizing drilling rate as a function of flow rate:

$$\frac{dR}{dQ} = \frac{K}{2}\left(\frac{Q^{2.16}\,P_s - G\,Q^4}{E}\right)^{-1/2} \times (2.16\,Q^{1.16}\,P_s - 4\,G\,Q^3) = 0$$

Then,

$$2.16\,P_s = 4\,G\,Q^{1.84} = 4\,P_c \quad (10)$$

$$P_c = 0.54\,P_s$$

What does Equation 10 state for the surface pressure limited case? Pressure loss in the circulating system should be 54% of the surface pressure. The remaining 46% of the available pressure or horsepower would then be used at the bit for optimum impact.

With the foregoing facts in mind, first step in calculating a hydraulic program using hydraulic impact is to select the circulation rate. Example 1 shows design of a hydraulic program where surface pressure is not limited. Conditions are the same as those for Example 2 in Part 9, where bit horsepower was the primary consideration.

Example 1. Assume that hole size is 9 in. Assume also that drill pipe is 4½ in. and consider that we are drilling at 10,000 ft. with 600 ft. of collars in 10-16-lb. per gal. mud. Surface horsepower available is 500 and the pump has a 16-in. stroke.

Experience indicates that annular fluid velocity should be at least 120 ft. per minute. Thus, we should choose the minimum permissible flow rate or the one necessary to provide an annular velocity of 120 ft. per minute. This calculates out to be 300 g.p.m. At 300 g.p.m., pressure loss in the circulating system (except bit) is 530 psi.

Available surface pressure

$$= \frac{500 \times 1{,}714}{300} = 2{,}855 \text{ psi.}$$

Pressure loss through bit

$$= (2{,}855 - 530) = 2{,}325 \text{ psi.}$$

Portion of surface pressure used at bit = 81.5%.

Remember, however, that Equation 8 says only 71% of the available pressure should be used at the bit to obtain optimum impact. Suppose, then, we increase flow rate. This reduces available pressure at the surface. As you can see, selection of an optimum circulation rate becomes a trial-and-error solution. Or, it may be solved graphically.

In graph form. First let's consider a graphical solution. Fig. 1 plots circulation rate versus pressure. Optimum rate of circulation at 10,000 ft. is 353 g.p.m. (Note at this point 71% of the available surface pressure is to be used at the bit.) Surface pressure is 2,430 psi. and pressure loss in the circulating system (except bit) is 705 psi. Therefore, the pressure loss at the bit is 1,725 psi. At 353 g.p.m. the annular velocity is 143 ft. per minute, above the minimum necessary to remove formation cuttings.

Is it optimum impact? Does 353 g.p.m. result in maximum hydraulic impact below the bit? According to our derivation in Equation 8, it should. We can check by assuming circulating rates above and below 350 g.p.m.

At 300 g.p.m., pressure loss would be 2,325 psi. through a bit with nozzle area of 0.195 sq. in. With these conditions the nozzle fluid velocity is 493 ft. per second and the hydraulic impact or drilling rate is:

$$R_i = K\,(353)\,(493) = 147{,}900\ K$$

Using 353 g.p.m., the pressure loss of 1,725 psi. through the bit requires a nozzle area of 0.256 sq. in. Resulting fluid velocity is 441 ft. per second and the hydraulic impact is:

$$R = K\,(353)\,(441) = 156{,}000\ K$$

If we use 400 g.p.m., pressure loss is 1,247 psi. through the bit and a nozzle area of 0.347 sq. in. is required. Resulting nozzle velocity is 369 ft. per second and the hydraulic impact is:

$$R = K\,(369)\,(400) = 147{,}600\ K$$

Our results verify Equation 8. Impact is greatest when pressure loss through the bit is 71% of the surface pressure. In this example, a circulation rate of 353 g.p.m. proved optimum.

Effect on drilling rate. What happens if circulation rate is 500 g.p.m.? Pressure available at the surface is 1,714 psi. and pressure loss in the circulating system (except bit) is 1,370 psi. This leaves 344 psi. at the bit when using a nozzle area of 0.82 sq. in. Nozzle velocity will be 195 ft. per second and the hydraulic impact is:

$$R = K\,(195)\,(500) = 97{,}500\ K$$

There is a reduction of 37.7% in hydraulic impact from optimum conditions and if more cleaning below the bit is needed, there may result the same drop in penetration rate.

TABLE 1

	Optimum rate of circulation, g.p.m.	Surface pressure, psi.	Bit pressure, psi.	Bit horsepower	Hydraulic impact
Bit hp.	300	2,855	2,280	400	0.947
Impact	353	2,430	1,725	355	1.000

Fig. 2 shows this; relative potential rate of drilling is plotted versus rate of circulation. In this case, optimum rate is considered unity.

Comparing with bit horsepower. To see how impact and bit horsepower compare, refer to Article 9, Example 1 (unlimited surface pressure).

Table 1 compares bit horsepower and hydraulic impact when there is no limit on surface pressure. As you can see, the rate of circulation for optimum bit horsepower is not the same as the rate for optimum impact. Reason is that bit-horsepower calculations use the minimum flow rate necessary to lift cuttings.

With hydraulic impact, the optimum circulating rate may be selected graphically or by trial and error. Annular fluid velocity is a limiting condition only; it is not predominant in selecting initial flow rate.

Surface pressure limited. Equation 10 is the basis for selecting rate of circulation when surface pressure is limited. Using the same conditions outlined in Example 1, assume surface pressure is limited at 2,000 psi. The problem is to design a hydraulics program to a depth of 15,000 ft. using hydraulic impact as the basis.

TABLE 2

Depth, ft.	Optimum circulation rate, g.p.m.	Pressure at bit, psi.	Nozzle area, in.²	Nozzle vel., ft. per sec.	Impact of relative drilling rate
2,000	500	1,214	0.44	368	184,000 K
3,500	450	1,350	0.372	387	174,000 K
5,000	430	1,400	0.35	393	169,000 K
6,500	430	1,260	0.37	372	160,000 K
8,000	430	1,150	0.385	357	154,000 K
10,000	430	1,000	0.410	336	144,000 K
12,000	410	920	0.410	336	137,000 K
15,000	370	920	0.370	320	118,500 K

Above 2,000 ft., formations are soft, drilling rates fast, and circulation rates high in order to clean the hole. Design of hydraulics program starts below this depth.

Table 2 includes the bit nozzles

and pumping speeds solved for the conditions in Example 1, but with surface pressure limited to 2,000 psi. Optimum circulating rates were chosen from Fig. 1 using Equations 8 and 10. Fig. 3 plots optimum circulating rates versus depth.

In most cases it is not possible to use the exact rate of circulation or nozzle area indicated. Actually, a variation of 25 to 30 g.p.m. reduces impact very little if surface horsepower is the same.

An in-between range. Table 2 includes two significant points we have not discussed previously. From 5,000 to 10,000 ft., circulation rate is constant at 430 g.p.m. This is a result of the limit placed on surface pressure. Beginning at 5,000 ft., if we circulated less than 430 g.p.m. we would use less than 500 surface horsepower. Thus, between 5,000 and 10,000 ft. it is better to hold circulation rate constant and use the maximum horsepower available. The alternative is to reduce surface horsepower by reducing circulating rate.

Below 10,000 ft., we reduce circulation rate so that we use less than 500 hp. at surface. Basis for this reduction is Equation 10. It shows that when surface pressure is limited, 46% of the surface pressure should be used at the bit.

Thus, above 5,000 ft., we used Equation 8 so that 71% of the available surface pressure was used at the bit. The interval between 5,000 and 10,000 ft. is actually an intermediate range that falls between Equations 8 and 10.

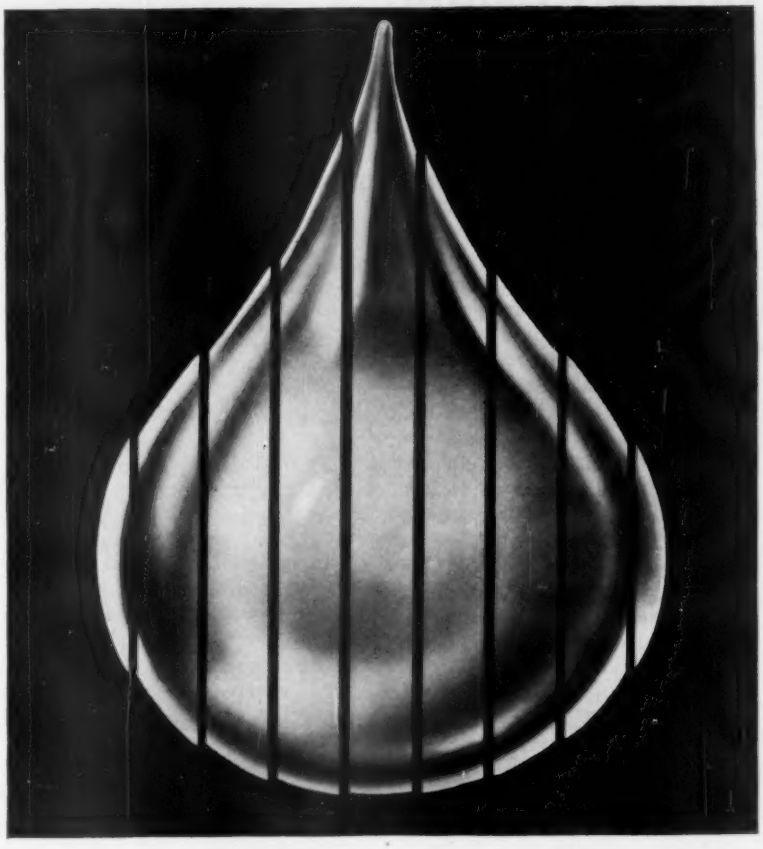
Because of the limit on surface pressure, the optimum conditions at 15,000 ft. use only 430 of the available 500 surface horsepower. Should we continue deeper with the same limitations, we would use even less surface horsepower.

We can show by example how limiting surface pressure affects hydraulic impact. Refer to the case where pressure was not limited at 10,000 ft. Then, optimum impact was 156,000 K, while in Table 2 it is 144,000 K. The use of an unlimited surface pressure (in this instance 2,430 psi.) increased potential drilling rate 8.4%.

Reference

1. Preston L. Moore, "Five Factors That Affect Drilling Rate": OGJ, Oct. 6, 1958, p. 141.

HOW THIN can you



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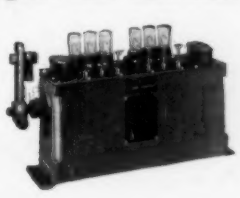

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How pH controls contaminated flood waters

BY GEORGE C. BERNARD
Pure Oil Co. Research Center
and
HENRY L. CHAMBERLAIN
Pure Oil Co. Producing Department

SERIOUS PROBLEMS can arise if incompatible waters are mixed on the surface prior to injection underground. Waters mix and react in the distribution lines, and a precipitate is formed that can plug the sand face of the injection well.

Because of special circumstances, we found it necessary to use a mixture of waters containing iron and sulfide in one of our floods. So we made a study of the problem and found that precipitation of H_2S in flood water can be prevented by moderate adjustment of pH.

How the reaction works. Let's consider the basic information given by ionization constants and solubility products.

Solubility of iron sulfide in a hydrogen sulfide solution depends on the concentrations of Fe^{++}, $S^{=}$, and H^{+}. The relationship between these quantities and the effect of pH on the solubility of FeS can be found in the following way.

Hydrogen sulfide is a very weak acid which dissociates in two steps:

$$H_2S \leftrightarrows H^+ + HS^- \quad (1)$$

$$HS^- \leftrightarrows H^+ + S^= \quad (2)$$

$$\frac{[H^+]\,[HS^-]}{[H_2S]} = K_1 = 8.4 \times 10^{-8} \quad (3)$$

$$\frac{[H^+]\,[S^=]}{[HS^-]} = K_2 = 1.2 \times 10^{-15} \quad (4)$$

In a suspension of FeS at equilibrium:

$$[Fe^{++}]\,[S^=] = 3.7 \times 10^{-19} = K_s \quad (5)$$

Multiplication of (3) by (4) yields:

$$\frac{[H^+]^2\,[S^=]}{[H_2S]} = K_1K_2 = 10^{-22} \quad (6)$$

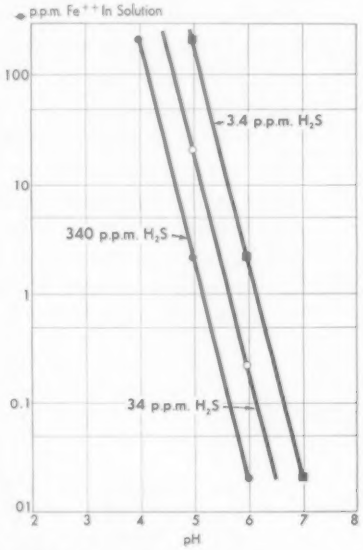
From (5) and (6) the amount of Fe^{++} dissolved is

$$[Fe^{++}] = \frac{K_s}{[S^=]} = \frac{K_s\,[H^+]^2}{[H_2S]\,[10^{-22}]}$$

$$= \frac{3.7 \times 10^{3}\,[H^+]^2}{[H_2S]} \quad (7)$$

Equation 7 shows that the greatest factor influencing the solubility of FeS in water is pH, because solubility of FeS depends on the square of the H^+ concentration. Thus, if the pH is lowered by one unit, solubility of FeS is increased 100 times.

The relationship in Equation 7 is shown graphically in Fig. 1. The graph gives the maximum concentration of Fe^{++} that can be held in solution having a given concentration of H_2S and a given pH. For example, a solution having a pH of 6 and an H_2S concentration of 3.4 p.p.m. can maintain a maximum Fe^{++} concentration of 2 p.p.m.



SOLUBILITY of iron sulfide increases at reduced pH levels at all concentrations of H_2S. Fig. 1.

The area under a given curve represents conditions of complete solubility, while the area above a given curve represents conditions of insolubility.

Experimental Results

Experimental results were obtained in the laboratory and in the field. For clarity and convenience these are described separately.

Laboratory results. The equations show that solubility of FeS in water is greatly affected by moderate changes in pH. However, these equations are known to apply exactly only to salt-free water. And it is well known that solubility of many compounds is affected by dissolved salts. Because of this and the fact that saline solutions are generally used in water floods, it was necessary to check Equation 7 by direct experiments with brine. This was done qualitatively by measuring the plugging characteristics of water containing FeS, at various pH values. A synthetic brine having the composition shown in Table 1 was used in all of the experiments.

TABLE 1—COMPOSITION OF SYNTHETIC BRINE

Constituent	p.p.m.
$MgSO_4 \times 7H_2O$	250
$CaCl_2$	1,800
NaCl	48,000
$NaHCO_3$	250
	50,300

For each experiment the desired initial concentration of Fe^{++}, H_2S and H^+ was obtained as follows: After the proper amount of hydrogen sulfide was dissolved in the brine, the pH was adjusted by adding NaOH or HCl and the resulting solution was filtered through a 200-md. fritted glass disk. Hydrogen sulfide content of the filtered brine was found by titration with standard iodine solution and starch indicator, and the pH was measured.

Next, to provide the desired amount of iron, ferrous ammonium sulfate was added to the hydrogen sulfide solution and the resulting mixture was allowed to stand for ½ hour. The plugging tendency of each mixture was found by passing it through a 200-md. fritted glass disk at 5-psi. pressure differential.

Time required to filter various volumes of solution was measured and the flow rate-time curves in Fig. 2 were plotted.

These curves, representing the filtration characteristics, were found to be in good qualitative agreement with predictions based on Fig. 1. For example, it is shown in Fig. 2 that brine initially containing 100 p.p.m. H_2S and 10 p.p.m. Fe^{++} plugs the filter very readily at pH 8 and pH 6, whereas at pH 5 the same brine has relatively good quality for injection. These results could have been predicted qualitatively from the data in Fig. 1 which show that fresh water containing 100 p.p.m. H_2S can maintain in solution less than 0.01 p.p.m. of Fe^{++} at pH 8, less than 0.1 p.p.m. of Fe^{++} at pH 6, but up to 7 p.p.m. of Fe^{++} at pH 5.

The top curve in Fig. 2 indicates that at pH 5 brine containing 34 p.p.m. H_2S and 10 p.p.m. Fe^{++} is almost free of plugging matter. This agrees well with data in Fig. 1 which show that fresh water containing the same solutes should be able to maintain 20 p.p.m. of Fe^{++} in the soluble state. It can be concluded that salinity does not greatly affect the solubility of FeS in water, and, therefore, calculated and experimental values for the solubility of FeS in water and brine, respectively, are in qualitative agreement.

Field results. The field test was carried out on a flood using a closed system supplied by two water sources. One water contained 4 p.p.m. of dissolved iron, and the other contained 20 p.p.m. of sulfide as hydrogen sulfide. The two waters were mixed at the plant in varying proportions; however, iron sulfide precipitate was present in all water leaving the plant. Analysis of the water mixture showed that generally the iron content varied from 1 to 3 p.p.m., and the H_2S content varied from 5 to 15 p.p.m. According to Fig. 1, it should be possible to prevent precipitation of iron sulfide by maintaining pH at about 5.7.

Quality of the injection water was first determined before acid was added. We decided that the most direct and reliable method of finding changes in the filtration characteristics of injection water was to use the membrane filter test.[3,4] Accordingly, a portion of the water from plant filters was passed through the membrane filter at constant pressure. A plot was made of filtration rate versus cumulative volume of water filtered, Fig. 3. The plot showed that the injection water was of poor quality.

The next step was to add sulfuric acid to the floodwater. By carefully adjusting acid feed, the floodwater pH was held between 5.6 and 5.8. A portion of the treated water from the plant filters was passed through the membrane filter, and the test data plotted in Fig. 3. A comparison of the curves clearly shows that at pH 5.7 the water had much better filtration characteristics than at pH 6.3. These results could be duplicated, and we decided that sulfuric acid addition should be made a permanent part of the operation. Flood has now operated successfully in this manner for 18 months.

Corrosion

In the absence of oxygen, even at pH 5.7, water should not be excessively corrosive. However, because of unusual conditions existing in this project, and the possibility that excess acid may be accidentally added to the water, it seemed advisable to add corrosion inhibitor to the system. The inhibitor (a nitrogen-containing compound) is added at a rate of 8 p.p.m. Test coupons show a corrosion rate of 0.1 m.p.y.

Total cost for both chemicals being added to the floodwater is about $1.10 per 1,000 bbl. of water.

Conclusions

Precipitation of FeS in floodwater can be prevented by moderate adjustments of pH. This idea has been tried and substantiated in a field test in which the floodwater was a mixture of waters containing sulfide and dissolved iron. Normally a mixture of such waters contains large amounts of insoluble, suspended FeS, and therefore is a poor injection water. Precipitation of FeS in this mixture of waters has been prevented by adding sulfuric acid, lowering the pH from 6.3 to 5.7. This method of water treatment has been used successfully for 18 months.

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3. Felsenthal, M. and Carlberg, B. L., Pet. Engr., 28, No. 12, B-53 (1956).
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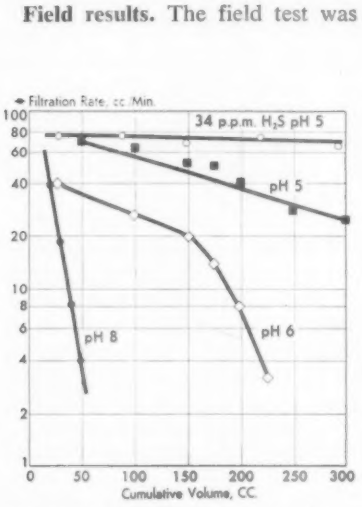
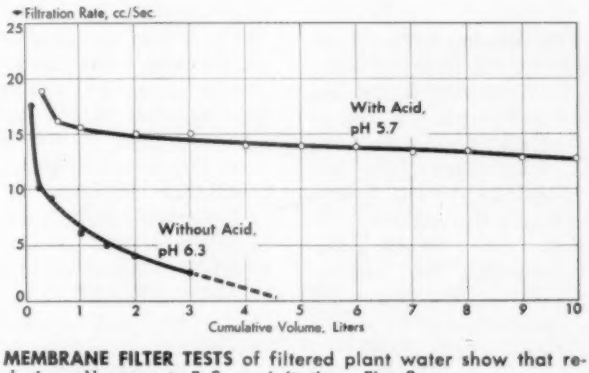


FILTRATION RATE of high-pH brines containing H_2S and Fe^{++} falls off faster than that of low-pH solutions. Reason is that filter becomes plugged with precipitated FeS. Brines initially contained 100 p.p.m. H_2S and 10 p.p.m. Fe^{++}, except as noted. Fig. 2.



MEMBRANE FILTER TESTS of filtered plant water show that reducing pH prevents FeS precipitation. Fig. 3.

On the Job

PIPELINING

Regular maintenance checks pay off

Two special crews maintain 36 gas turbines in 12 compressor stations on a scheduled basis.

TURBINES are overhauled about once every 3 years in the 12 turbine-equipped compressor stations along El Paso Natural Gas Co.'s southern division. This is more frequent than absolutely necessary but overhauls in anticipation of trouble have paid off.

El Paso's southern division has two six-to-eight-man crews to perform turbine overhauls. Each is headed by a subforeman under the foreman for gas-turbine maintenance. These crews do almost all the work but, when necessary, a substitute crew made up of chief maintenance mechanics from various stations is pressed into service.

Each of El Paso's 12 turbine stations has 3 turbines. The turbine and electrical maintenance department keeps individual records on all 36. These records tell when maintenance was last performed, what kind of work was done, and when the next overhaul should be scheduled.

Takes 800 man-hours. Overhauls are scheduled when they will interfere least with company operations, mainly during the summer. Ten or eleven overhauls are completed each year. Each takes about 800 man-hours including about 5 days just to dismantle the engine.

Largest part of a turbine overhaul is dismantling the turbine. First, the compressor is taken off the line; pipeline gas is routed through the two active compressors and back into the mainlines. Then the gas-turbine engine is shut off. Piping to the engine is disconnected and removed. This includes pipes for fuel, pipes that deliver oil to the drive-shaft bearings, and pipes that deliver cooling water to the gas nozzles that feed the expanding gases, after burning, toward the buckets of the turbine wheels. These lines are checked to be sure they are free of obstructions.

DISMANTLING TURBINES is most time-consuming part of overhaul, requiring about 5 days, an 800-man-hour job.

The crew then moves the six combustion chambers on the side of the engine. Half the metal cage that covers the turning turbine wheels then comes off, followed by the second half of the cage. With the turbine wheels exposed, the men unbolt the second-stage wheel from the compressor impeller and remove it. Next, they unbolt and remove the first-stage wheel from the axle flow compressor.

Checked in shop. Between the turbine wheels and the air intake is the axle flow compressor, a cylinder-shaped part with small metal blades covering all sides. Connected to the first-stage wheel, the axle flow compressor rotates rapidly, compressing the incoming air before it goes to the regenerator for heating.

These three parts—the two turbine wheels and the axle flow compressor—are loaded in trucks and driven to the machine shop. Shop employes check the turbine wheels for cracks or flaws. They remove

THRUST-BEARING CLEARANCE is checked with dial indicator, one step in the overhaul of the company's 36 turbines, each every 3 years.

RECORDS ARE KEPT of each overhaul. Here engineer is checking thickness of shim to insure correct distance and alignment.

the buckets on the rim, and individually clean and inspect them.

The wheel itself must be in perfect balance, and special machines check the precise metal displacement. If the metal is worn off on one spot, the entire wheel is polished and smoothed until perfect balance is restored. A slight imperfection could do serious damage by causing the wheel to vibrate; this vibration could break the drive shaft. When the wheels and axle flow compressor are checked and approved for further use, they are returned to the station where the overhaul is proceeding.

Parts steam-cleaned. At the station, the combustion chambers of the engine have been cleaned with wire brushes. Every part of the engine, every bolt, every strip of metal have been steam-cleaned and polished. Every piece is checked for cracks and chips.

Where there is a drive shaft, there must be a bearing. In gas turbines there are five bearings. The overhaul crew must take each apart to see that all parts are uniform and to make certain the oil seals are intact so that the bearings will be properly lubricated. When thoroughly cleaned and inspected, bearings are replaced on the drive shafts.

Acid is forced through the second-stage nozzles that direct the expanding gases through the second-stage turbine wheel. Each wheel has a separate set of nozzles. Nozzles for the first-stage wheel are stationary, but the nozzles for the second stage are variable, and the operator can change the direction of gas flow.

The speed and operation of the second stage wheel can be controlled by changing the angle of the moving gases. These nozzles are water-cooled, and the crew cleans the water jackets to remove any mineral deposits that may have collected during operation.

Future aids. An engineer supervising the overhaul can give helpful information for future day-to-day maintenance work. Engineers carefully examine each piece of equipment as the crew removes it from the engine. Every bearing is checked, according to a prepared chart, and any discrepancies, such as undue wear, foreign particles found in any part of the engine, or unusual operations, are noted. In later work, engineers can apply knowledge gained on one maintenance overhaul to another. The end result: Better maintenance for the company's turbines.

The engineers inspect every part of the turbine to see whether new equipment is needed. When the turbine wheels and axle flow compressor come back from the machine shop, the turbine is ready for reassembly.

Instrument men come to the station to inspect the turbine's three main instruments: The gas-control valve, the pressure-ratio valve, and the fuel regulator. Gas fuel comes to the turbine at about 125 psi. If the air pressure is 60 lb., the pressure-ratio valve reduces the pressure of the fuel to exactly 90 lb., providing the proper gas-air mixture. The gas-control valve, regulated by a signal from the fuel regulator, makes a final pressure adjustment on the fuel pressure before the fuel goes to the firing chamber.

The job of fitting all parts precisely in the engine is exacting, and the task takes a number of full days' work. When the job is finished, the gas turbine is ready for another 3 years' successful operation. It's a credit to the maintenance crews that, with proper overhauls, done according to proper schedules, El Paso Natural's engines seldom shut down for emergency repairs.

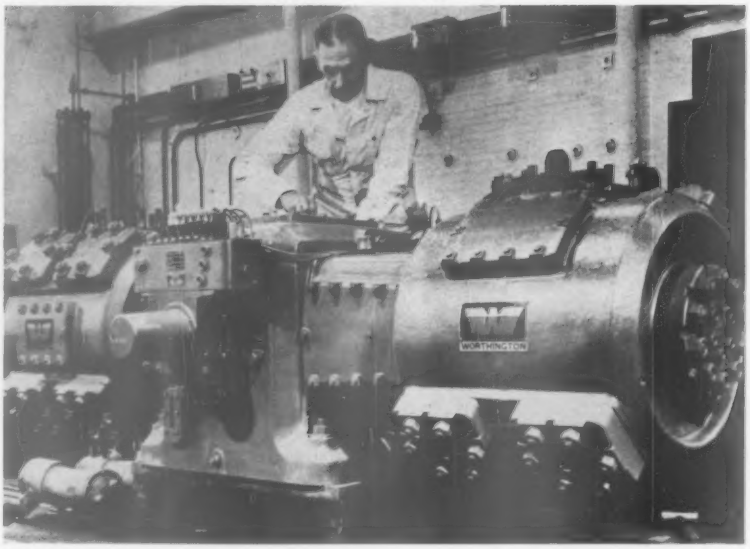
▶ ▶ ▶ New Equipment Section

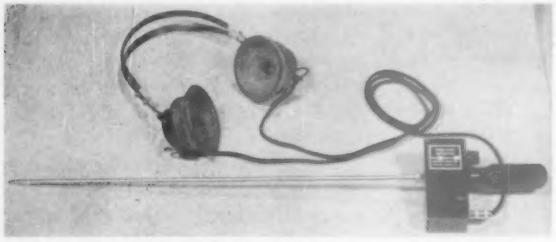
This week's SHOWCASE features . . .

Newest natural-gas compressor

. . . to be announced is this Model CUB unit which is to be initially offered for pressures up to 2,000 psig. in ratings between 200 and 350 hp. The compressor is a balanced-opposed type for high-speed operation in compressing natural gas in gas-gathering, gas-lift, repressuring, and other field uses involving semiportable compressor units in this horsepower range.

Operating at 1,000 r.p.m., the compressor has a 5-in. stroke and two cylinders. It is designed for unattended outdoor installation and for direct coupling to a high-speed gas engine. The maker says the unit's opposed piston design offers better balance, compactness, and a low weight per horsepower. Source: **Worthington Corp., 426 Worthington Ave., Harrison, N. J., U.S.A.**





Detector locates vibration

. . . in machinery and equipment caused by mechanical sources. The Model CTA detector, an electronic type, detects and localizes mechanical vibrations. Such vibrations are picked up by a steel probe and transmitted to a transducer. The transducer converts the vibrations into an electric voltage which varies with the vibrations.

Transducer output feeds into a transistor amplifier. Amplifier output energizes the headphones. Ear cushions on the headphones minimize ambient noise. One control serves as the on-off switch and volume control. Penlight batteries power the detector.

The detector promises to prove valuable for a variety of vibration problems such as checking mud valves on mud pumps, working of downhole valves, gas-lift valves, gas-compressor operation, and a variety of other equipment.

The case measures 4⅛ by 1¾ by 1⅝ in. The probe measures ½ by 20 in. Net weight is 1.8 lb. Source: **Engineering Research Corp., Linwood at Dazell, Shreveport, La., U.S.A.**

●

Improved mud pump

. . . has been announced. The Model GX mud pump, a 14-in. stroke unit rated at 500 hp., now features a cast-steel fluid end with threaded valve covers and threaded cylinder heads. Optional are alloy-iron cylinders and a bolted type of valve

Want more facts about equipment or copies of product literature described in this issue?

Send this **Showcase Coupon**

to manufacturer at address shown in bold type after each item.

Product name, Model no., literature title or number: .....

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SHOWCASE . . .

New Equipment

cover. The unit is designed for high-pressure drilling to meet deep-hole needs. Source: **Gardner-Denver Co., 100 Williamson, Quincy, Ill., U.S.A.**

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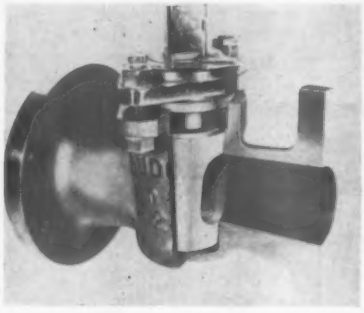


Plastic-sleeved plug valve

. . . is available in sizes from ½ to 4 in. and made of three materials: stainless and alloy steel and cast iron. The valve is expected to prove useful for severely corrosive services. Maximum working pressure is 150 psi. at 212° F. Source: **Audley Engineering Co., Ltd., Newport, Shropshire, England.**

•

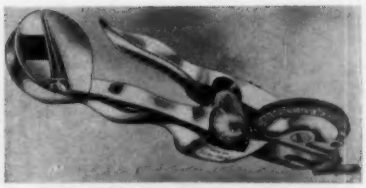
Closed-circuit TV monitors

. . . recently announced are said to provide an expanded brightness range that fits the monitors for operation in areas of high ambient light. An accessory polorized safety glass face plate is available for obtaining additional effectiveness in minimizing reflections and improving the contrast ratio.

The monitors are expected to prove useful for meter reading, process control, security surveillance, pipeline inspection, data display, technical instruction, and related uses.

The maker says the monitors are capable of three times the picture quality of home sets, yet they are simpler to maintain and adjust. They operate with any standard monochrome camera.

Featuring an 800-line minimum horizontal resolution, the monitors come in cabinets or rack-mounted in three screen sizes: 14, 17, and 21 in. Source: **General Electric Co., Communication Products Dept., P. O. Box 4197, Lynchburg, Va., U.S.A.**



Hand embossing tool

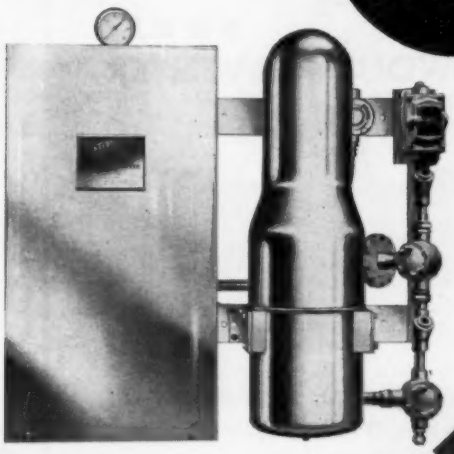
. . . permits the user to set letters on a dial and merely press to emboss a label. A built-in cutoff blade trims the label to desired size.

The embossing dies are designed to give sharp, raised letters on a

OPTIMUM RETURNS THROUGH QUALITY CONTROL

• **A proved cost-cutter,** now operating in over fifty refineries, gasoline, and chemical plants. • **Increases yield and improves quality** by accurately and **continuously** monitoring ASTM end-point. Delays between quality change and compensating control are eliminated. Allows closer operation to end-point specifications. • **Reproducibility** far exceeds laboratory method. • Write for Technical Bulletin 5900-11.

Maximize your profits with the TOTCO END-POINT ANALYZER



Totco also makes an Initial Boiling Point Analyzer. Write for Technical Bulletin 1259-11.

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Gulf Coast Representatives: The Mott Co., 1719 McKinney, Houston 1, Texas

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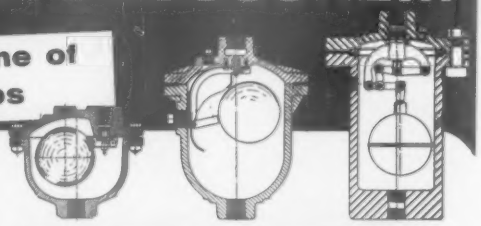
Select from the complete line of Armstrong Ball-float Traps



Corrosion-Resistant Parts—stainless steel standard . . . also available in nickel, monel, various grades of stainless, and other weldable materials which can be fabricated, cast or forged.

For Any Pressure—special designs for particular needs . . . standard to 1000 psi.

For Any Capacity—three types for most economical application to your conditions.

Moderately Priced—due to mass-production economies from using many of the same basic parts used in the production of thousands upon thousands of Armstrong steam traps.

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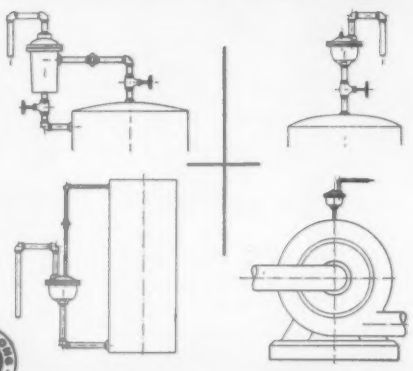
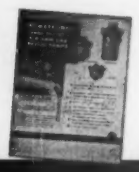
Unconditionally Guaranteed—to satisfy on a money-back basis.





Send for Helpful Bulletin—Bulletin 4501 tells how to select and install gas-relief traps, gives complete physical data and prices of Armstrong vent traps.

For your copy, call your local Armstrong Representative or write today to:

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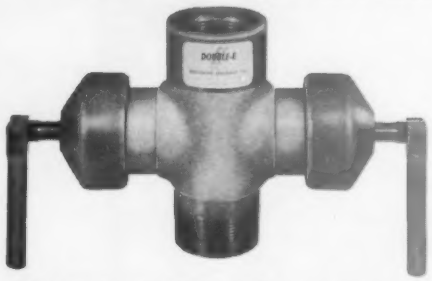

Holds to 3,000 psi against all diameters 0″ to 1½″. Prevents blowouts when you pull rods or replace stuffing box rubbers.

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variety of the maker's vinyl tapes. Metal tapes are also available.

The Tapewriter M-2 embossing tool offers a convenient way to prepare labels for a variety of equipment and machinery. Source: **Dymo Industries, Inc., 2725 10th, Berkeley 10, Calif., U.S.A.**

•

Industrial vacuum cleaner

. . . operates on compressed air using a venturi system to create a strong cleaning ability. One feature of the vacuum cleaner is that it requires no electric power. And it has no moving parts to require maintenance.

The maker says the device will pick up most objects that will pass through a 2-in. pickup hose, and that it will pick up sand at the rate of 5,000 lb. per hour and liquids at the rate of almost 6,000 gal. per hour.

The cleaner is available as a cover assembly in sizes to fit 30 and 50-gal. drums. Source: **Northeast Industries, Inc., Midland Park, N. J., U.S.A.**

•

Flame ionization analyzer

. . . combines the high speed and resolution of small packed or capillary columns with the sensitivity of flame ionization detection, the maker reports. The Micromalyzer, a Shell Development Co. design, includes a 30°-to-150° C. thermostatically controlled oven and an electrometer amplifier housed in a vinyl-clad, aluminum cabinet. The cabinet measures 13¾ in. wide,

Why DARLING-McEVOY 2-way conduit gate valves

JUST CAN'T LEAK!

Section view of Darling-McEvoy 2-way conduit gate valve, showing twin sealant reservoirs, double-gate parallel seat design, and sealing grooves. Sizes: 8 inch and larger.

IT'S simple. Regardless of flow direction, a sealant *automatically* completes a pressure-tight seal between the downstream seat and gate. This is the inevitable result of pressure differential at the time of closure.

Similarly there can be no behind-the-seat leakage! For, as shown here, each seat is *double-grooved* to seal against the valve body as well as the gate.

It is this unique feature, with its positive, automatic self-sealing, that establishes the Darling-McEvoy conduit gate valve as the world's tightest!

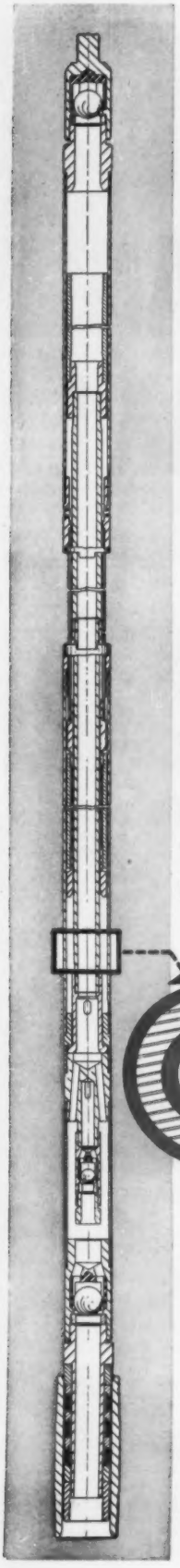
Isn't it likely that you could benefit by such valve performance as time goes on? Get the *whole* story . . . get details on this and the other unusual features that make these field-proved valves truly outstanding for low-cost, trouble-free operation. Just ask for Bulletin 5402.

DARLING VALVES

DARLING VALVE & MANUFACTURING CO.

Williamsport 1, Pa.

Manufactured in Canada by Sandilands Valve Manufacturing Co., Ltd., Galt 19, Ont.



Get More Production with

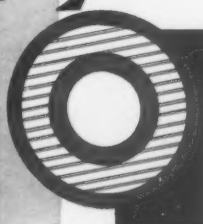
PACIFIC'S DOUBLE BARREL

Insert Rod Plunger Pump

This particular design of Pacific's Type "D" Insert Rod Pump is one of the many tried, and is the direct result of engineering proved by actual field tests and operation. Over a period of years this pump was developed so that it could be removed on the rods for servicing ... yet produce at capacities equal to or greater than a Tubing Liner Pump. Many problems were encountered, but for each a satisfactory solution was found. The result is a most efficient and trouble free insert rod pump for handling large capacities.

The Type "D" Insert Rod Pump consists basically of two R. W. pumps in tandem. The upper pump is a Traveling Barrel Pump. The lower pump is a Traveling Plunger Pump.

WRITE FOR BULLETIN 204



Vertical cross sectional view of lower pump displacement chamber showing area which is between Inner Plunger Tube and Precision Tube. This area represents approximately 60% of the upper pump. Both pumps load on the up stroke and discharge on the down stroke.

PACIFIC PUMPS

Inc... A Division of Dresser Industries, Inc.

HUNTINGTON PARK, CALIFORNIA

Mid-Continent :
1358 So. Sheridan Ave., Tulsa 12, Oklahoma
Pacific Pumps of Canada, Ltd.,
Edmonton, Alberta

PACIFIC

DW-19

9 3/16 in. deep, and 11 in. high.

The thermostated oven is fixed to the bottom of the cabinet. The front panel and top are one piece. Handles are provided to lift the assembly out of the cabinet.

The column, detector, and all pneumatic connections are mounted on the top at the left. The electrometer controls, power switch, pilot light for the thermostat, and push-button for the flame igniter are all mounted on the right of the front panel.

The electrometer circuit provides full scale sensitivities of 3 x 10-11 amp. with a 10 mv. recorder. The instrument weighs 30 lb. Source: **Hallikainen Instruments, 1341 7th, Berkeley 10, Calif., U.S.A.**

●

Compact photoswitch

. . . has been brought out that is said to be capable of turning 1,500 watts of incandescent lamp load on at dusk and off at dawn. The Lightguard switch measures only 1¾ in. long and 1¾ in. in diameter.

The switch requires a 1-in. electrical knockout for mounting. Operating on 120-volt a.c., it uses a tubeless electronic circuit with a hermetically sealed photoconductive cell.

The switch turns on at about 1 ft.-candle and turns off below 10 ft.-candles. But it can be obtained with an adjustable light-level control. A 30-to-60-second time delay is incorporated to prevent operation by momentary flashes of light.

The maker says the switch operates at the same light level over an ambient temperature range from −30° to 140° F. Provided with 9-in. leads, the device is sealed in a laminated-phenolic case to keep out dust and moisture. Source: **Lightguard Electronic Mfg. Co., Inc., 1213 Saint Emanuel, Houston 3, Tex., U.S.A.**

SHOWCASE . . .

New Equipment

Pump moves 755 bbl. per day

. . . at 3,500 psi. with 1¼-in. plungers and 1,940 bbl. per day at 2,000 psi. with 2-in. plungers. The Series 3400 pump is a horizontal triplex plunger type, with a 4-in. stroke, designed to provide high-pressure pumping for small-volume waterflood projects and well-servicing operations.

Maximum speed is 350 r.p.m. The fluid-end body, valve, and seat assemblies and the plungers come in several materials. Source: **Gaso Pump & Burner Mfg. Co., 900 East First, Tulsa, Okla., U.S.A.**

●

Eight-string christmas tree

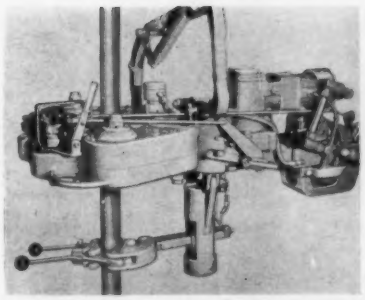
. . . has been developed for use on a multiple-completion well. The tree assembly is designed to support four strings of 2½-in. tubing, each containing a string of 1½-in. tubing.

The casing head is fitted with a free-floating flange that does not need aligning pins. A quadruple master bushing is used to support threaded hangers for the 2½-in. outside tubing string. Four small tubing heads are used to support the 1½-in. macaroni strings. The wellhead permits running of turbulizers, centralizers, or other tools through the hangers. Source: **Oil Center Tool Co., Box 3091, Houston 1, Tex., U.S.A.**

●

New aid for power tong

. . . is this semiautomatic backup attachment. It is designed to prevent the lower section of a tubing string from turning in the slips while a



stand is being made up or broken out. The maker claims it eliminates a separate manual backup tong and a hanging line.

The attachment weighs 30 lb. and fastens to the under side of the power tong by welding. It is spring-balanced so it will be easy to position vertically. A sliding lever aids horizontal spotting and gives access to the tubing joint in the retracted position. The backup device has a toggle type of action for fast gripping. It can be quickly latched on or off pipe by the tong operator. Available jaw sizes range from 2⅜ to 4½ in. Source: **Byron Jackson Tools, Inc., Box 2017, Los Angeles 58, Calif., U.S.A.**

streamlined production

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Enardo, the company who pioneered a whole new concept in lease storage equipment, has again taken a major stride forward by instituting a totally new program of engineering and management services plus a complete revitalization of production facilities. Because of these streamlined methods, Enardo Thief Hatches, Vent Valves, Burner Assemblies and other items in a complete line of oil field accessories have been lowered in price, yet maintain their unsurpassed quality. Another innovation at Enardo is the improved inventory control system. Upon receipt of an order, the item is located, packed and on its way to the customer within minutes! All this adds up to greater savings, better products and speedier deliveries when you specify Enardo equipment for your lease. Call, write or wire Enardo Manufacturing Co. for further information.

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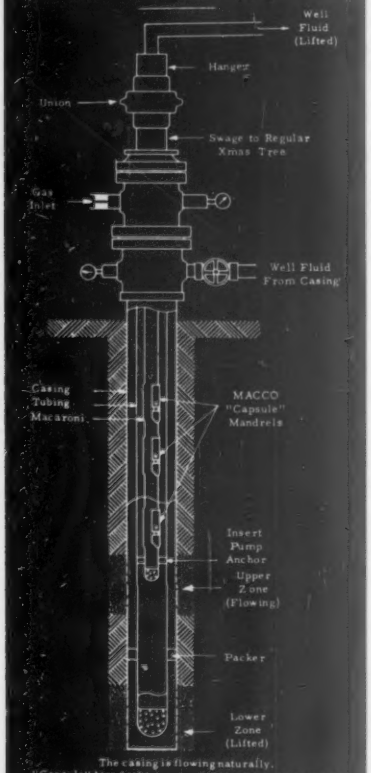
MACCO

MACCO MULTIPLE COMPLETION AND SLIM HOLE EQUIPMENT

The "capsule" type mandrel is available from stock for all standard multiple string, macaroni, and slim-hole gas lift. Special sizes are manufactured upon request. With the valve and check valve mounted inside, this type of mandrel provides extra large flow areas for the well fluids. The producing zones of parallel or concentric multiple completions may be simultaneously lifted by either a "common" or "separate" gas supply.

Macaroni tubing lowered inside of the regular tubing has proved a highly successful means of lifting wells where it is objectionable to pull the regular tubing. Efficient lift inside of small liners is also made possible.

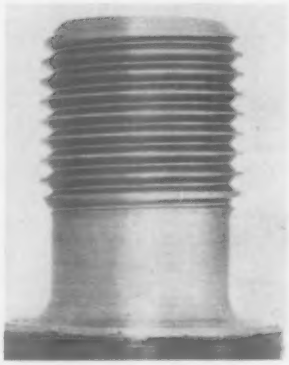


The casing is flowing naturally. "Capsule" Mandrels are run inside the regular tubing.

Macco manufactures many different types of multiple completion equipment to fit any well requirement. For further information, write for Brochures Nos. 3-12, 3-13, 3-21, 3-31 and 6-12.

MACCO OIL TOOL COMPANY, INC.
Houston 8, Texas
7521 Prince P. O. Box 7288 Houston 8, Texas
Phone UN 1-1253

MACCO equipment is also available in sterling areas from Williams & James (Oil Tools) Ltd., Gloucester, England



Newest sucker rod design

. . . now on the market features a rolled thread and undercut pin. According to the maker, the design eliminates two points of pin failure. The rolled thread is formed by cold working or displacing the metal into the thread form. This is said to give a dense structure at the thread root. Undercutting the pin shank is said to overcome the problem of the runout thread and to improve elasticity in absorbing the alternating stresses of the pump cycle. Source: **S. M. Jones Co., 515 Enterprise Bldg., Tulsa, Okla., U.S.A.**

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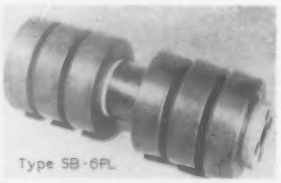


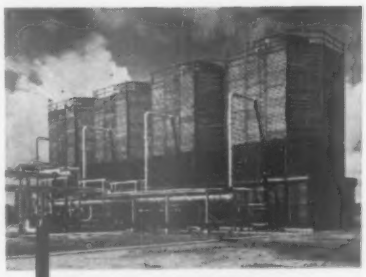
Plastic pipeline pigs

. . . now on the market can serve a variety of purposes in pipeline operation—separate dissimilar fluids, displace gases with liquids and liquids with gases, remove condensate from gas lines, and other similar operations.

The two models of the plastic pig, SBN-5PL and SB-6PL, are designed to minimize slippage.

The pigs need no inflation or deflation. They come in sizes from 4 to 14 in. Source: **T. D. Williamson, Inc., Box 40, Tulsa 2, Okla., U.S.A.**

NEW LIFE FOR OLD COOLING TOWERS



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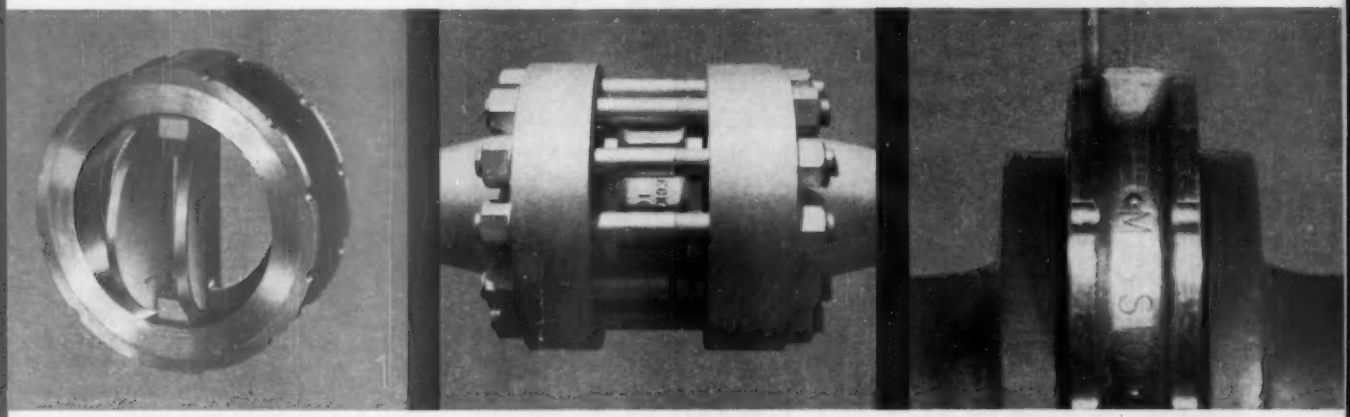
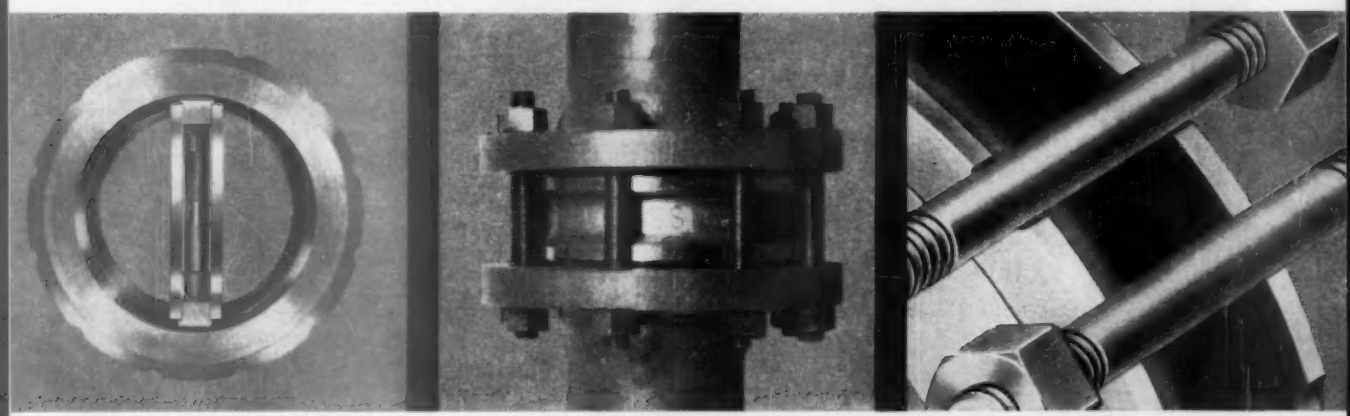


Because of its sound, imaginative design, the Duo-Chek check valve is smaller, uses less material, and costs less to buy. It costs less to maintain and lasts longer, too.

A Duo-Chek check valve weighs on the average less than ten per cent, with some models weighing only two per cent, as much as conventional check valves for the same service. No foundations are needed.

The Duo-Chek fits between the flanges, is smaller and weighs less. For example, a 6-inch steel valve, series 300, weighs 29 lbs., requires no special installation equipment.

NO SLAM—ANY POSITION—CUTS INVENTORY



A stainless steel coil spring effects positive sealing action. The quick action of the spring closes the valve before reverse flow can occur. Result: No slam, no water hammer.

The Duo-Chek simplifies piping arrangements. The spring loaded plates operate in any position. Most popular sizes can be installed even in vertical lines with downward flow.

The unique versatility of the Duo-Chek greatly reduces inventory. In sizes 2 through 12 inch, one valve fits both series 150 and 300 flanges; 2- and 3-inch sizes fit series 600, too.

MISSION **DUO-CHEK** CHECK VALVE

The Mission Duo-Chek® check valve performs all regular check valve duties, yet is smaller, lighter, and easier to install. Duo-Chek check valves are available in a complete range of sizes from 2 to 48 inches, ASA Series 125 through 2500. They come in various end connections, such as raised face, ring joint, weld neck, etc. They are made in carbon steel, stainless steel, aluminum, and bronze. Special alloys are available. Because of the small size of the Duo-Chek, special alloy valves cost much less than conventional valves in the same alloy.

Sealing material is bonded in a groove in the plate. The sealing material makes an O-ring seal, which pressure deforms until metal-to-metal contact is made by the plate and body seat. Sealing material may be Buna-N, Teflon, Viton, or metal, depending on the service.

The simplicity of design of the Duo-Chek pays off in every installation with longer life and less maintenance. Only six parts are contained within the body of the Duo-Chek, held without the use of internal fasteners or joints of any kind. All parts are interchangeable.

The Duo-Chek is much lighter in weight than conventional check valves, yet is stronger. By dividing the opening, the unsupported plate area is reduced so that each plate requires only one-eighth of the weight of a conventional clapper of the same strength. The short stocky body is inherently stronger and more rigid than a short length of heavy wall pipe.

Whatever your check valve application, the Mission Duo-Chek can cut initial purchase and installation costs, cut maintenance costs from then on. Contact Mission now for a representative.

MISSION VALVE AND PUMP CO. A SUBSIDIARY OF MISSION MANUFACTURING CO. P. O. Box 4209, Houston, Texas • Cable Address 'MISSCO' • Export Office: 30 Rockefeller Plaza, New York • In the United Kingdom: MISSION MANUFACTURING CO., LTD., 1 Hanover Square, London W. 1 England • Cable Address 'MISSOMAN' • Sold by Mission Manufacturing Company outside of Canada and the U.S.A.

MISSION VALVE AND PUMP CO.

SHOWCASE . . .

New Literature

Security gates

. . . for insuring tighter control over refinery entrances and exits, industrial plants, truck terminals, and processing plants, are detailed in a four-page literature piece presently available. It describes a mechanism said to operate any gate arm, up to 16 ft. long, through the full 90° of travel in just 4 seconds. The gate arm is locked in place when at rest in any position by means of the worm-gear reducer and crank operator. Source: **Western Industries, Inc., 2742 W. 36th Pl., Chicago 32, Ill., U.S.A.**

Ball and socket joints

. . . that are said to be leakproof at all pressures of water, steam, oil, compressed air, and chemicals, are illustrated and described in a new 16-page brochure just made available from an English manufacturer. The literature offers photographs, sizes, working pressures, applications, and features. Source: **W. G. Bagnall, Ltd., Castle Engine Works, Stafford, England.**

Compound retards gyp deposit

. . . in and near the well bore, on downhole equipment, and on surface well equipment, as explained in a newly announced two-page product data sheet. The phosphate compound — tradenamed "Gypban"—is supplied in several solubility ranges to meet specific treating problems. The data sheet offers answers to what it is, what it does, where it is used, along with advantages and physical properties. Included are case histories, packaging and availability, and prices. Source: **Dowell Division of The Dow Chemical Co., Box 536, Tulsa, Okla., U.S.A.**

Removal of hydrogen sulfide

. . . from gases is described in Publication 84, four pages. The new liquid process — known as "Stretford"—can be used for cleaning up synthesis gas and petrochemical feed stocks where low hydrogen sulfide burdens are demanded, the literature reports. It adds that the method can also be applied to the liquid phase extraction of dissolved hydrogen sulfide in distillate fractions. The publication includes a flow diagram of a typical installation. Source: **W. C. Holmes & Co., Ltd., Box B7, Turnbridge, Huddersfield, England.**

Automatic tank gages

. . . Figure 2500 series, are detailed in new four-page Bulletin CP3302 now available. It includes features and installation diagrams of the tank gages—designed for 150 and 300-lb. range in small high-pressure tanks; larger high-pressure tanks (avoiding long runs of horizontal piping); or top-reading high-pressure tanks (above or below ground). Source: **Vapor Recovery Systems Co., 2820 N. Alameda St., Compton, Calif., U.S.A.**

New pumping unit

. . . the Series 60, with integrated truss construction, is detailed in a new booklet. Explained are its service advantages over convention-

TEN YEARS' EXPERIENCE . . .

. . . in custom design, engineering and fabrication of heat transfer equipment for gas treating, processing, and allied industries.

Let our staff of specialized, experienced gas treating and processing engineers consult with you at no obligation on your specific heat transfer problems.

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ENGINEERED PROCESS EQUIPMENT CO
774 E. Green • MU 1-6663 • Pasadena, Cal.
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JOE KLIPPER
P. O. Box 3266
TE 3-1879
Beaumont, Texas

REX BIRCKET
424 So. Cheyenne
LU 4-6631
Tulsa, Okla.

ally designed pumping units. Eight-page Booklet 1669 describes the unit's features which include a convenient servicing platform, prelubricated bearings, hydraulic wrist pins, economical gear reducer, counterbalance cranks, and a fold-under horsehead. Source: **Supply Div., Bethlehem Steel Co., 21 E. Second St., Tulsa, Okla., U.S.A.**

Pipe and tubing measurement

. . . Bulletin 631 supplies conventional methods of measurements, discussing both the similarities and differences involved in measuring various fittings and fluid-carrying lines in order to arrive at satisfactory fluid-line installations. The 16-page literature discusses practices of measuring adapters and complete assemblies. It also explains in chart form the dash numbering systems commonly used in pipe and tubing measurements. Source: **Aeroquip Corp., Jackson, Mich., U.S.A.**

Free piping-system drawing template

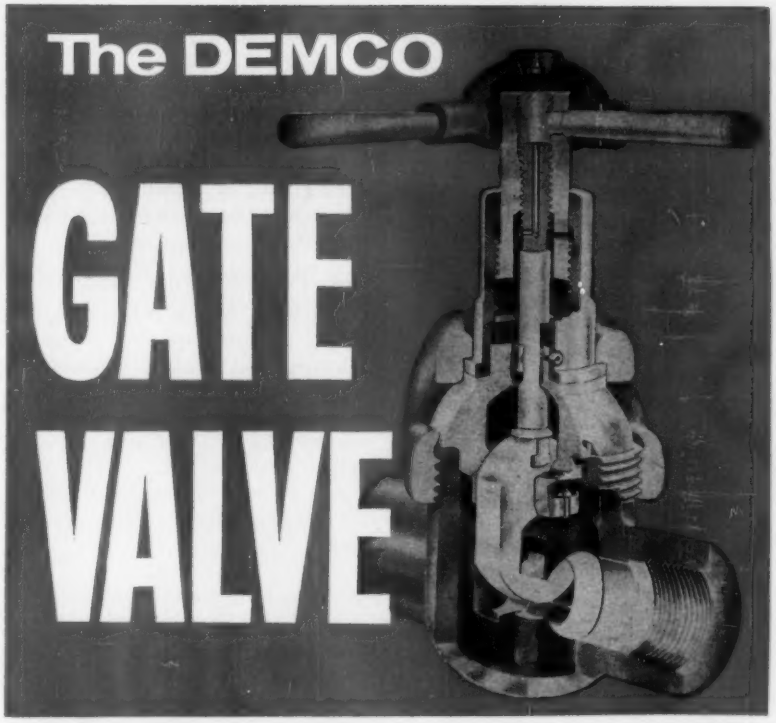
. . . for welding fittings is presently being given to interested persons. Including the most commonly used welding-fitting shapes, the new template promises to speed design and drawing time on welded piping systems. Source: **Bonney Forge & Tool Works, Allentown, Pa., U.S.A.**

Hand trucks

. . . for handling various types of merchandise in stock rooms and stores, for parts and materials handling, pipe, tubes, etc., are discussed in a newly released 24-page pamphlet. It gives models available, construction materials, applications, and dimensions. Source: **Rol-Away Truck Mfg. Co., 6143 S.E. Foster Rd., Portland 6, Ore., U.S.A.**

Crossing guard

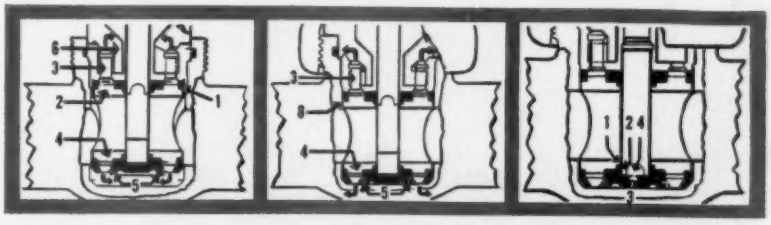
. . . called "Guardmaster," for use at industrial crossings, where railroad tracks are installed, is featured in a two-page bulletin obtainable now upon request. According to the literature, the rigid steel bar provides a smooth surface between tracks so heavy vehicles can cross without bumping, jolting, or overturning. Source: **Western Railroad Supply Co., 2742 W. 36th Pl., Chicago 32, Ill., U.S.A.**



Seals DROP-TIGHT without "bumping"

Positive sealing under the highest line pressures—*with minimum torque*—makes the Demco GATE VALVE your best buy for every mud line application . . . for water flooding, hydra-frac, acidizing and cementing service . . . and for many production applications.

Demco's secret lies in its unique one-unit seal assembly, with its patented spread-ring construction. Here's how it works . . .



A. Resilient seat assembly (1) is reinforced with steel wear rings (2), having integral projecting pins at top (3) and bottom (4). In normal contracted position, the seat assembly is easily inserted in, removed from the body. Until the seat assembly is bottomed, the steel spread ring (5) does not act upon the lower projecting pins, nor do the bonnet lugs (6) act upon the upper pins.

B. With the bonnet down and the seat assembly bottomed, the spread ring (5) has forced the lower projecting pins (4) outward. Similarly, the upper pins (3) have been wedged outward by the descending bonnet lugs, providing a tight seal between body wall (8) and seat, preventing entrance of abrasives between seat and body wall.

C. As gate is closed, leading edge of gate slides past wear ring (1), contacts rubber ring (2) for positive rubber-to-metal seal. Seal occurs before gate touches rubber cushion (3), eliminating need for "bumping." Relief in bottom of gate (4) allows straddling of solid particles that might interfere with proper closure.

Available at supply stores everywhere in 1,000, 1,500, 2,000, 3,000 and 5,000 psi working pressures . . . in two-, three- and four-inch sizes.

DRILLING EQUIPMENT MANUFACTURING CO.

Oklahoma City, Oklahoma

DRILLING EQUIPMENT MFG. CO. DEMCO OKLAHOMA CITY, OKLA. U.S.A.

▶ ▶ ▶ New Equipment Section

Chicago Pneumatic Tool boosts

C. L. Griffin

. . . C. L. Griffin, former general sales manager of the Oil Tool Division, to general manager of the division. He replaces G. A. May who has been elevated to executive vice president and general manager of Allen Mfg. Co., Bloomfield, Conn., a wholly owned subsidiary of Chicago Pneumatic. Griffin will continue to locate at the Oil Tool Division's manufacturing facility at Fort Worth.

Prior to his association with Chicago Pneumatic, Griffin was vice president in charge of sales for Security Engineering Division of Dresser Industries. He has been associated with the petroleum industry for the past 26 years.

W. Kelso Woodward becomes

. . . manager—sales administration of Axelson-Garrett Division of U. S. Industries, Inc., in which post he will be responsible for the division's material control, warehousing, sales engineering, and export sales. He will headquarter at the division's plant and general sales office in Houston.

A division employe since 1952, Woodward previously served as West Texas district sales manager and Houston city sales engineer. He formerly worked for Lone Star Producing Co., of Athens, Tex., and Geological Engineering Service Co., Fort Worth.

Gaso Pump & Burner appoints

. . . Midway Supply Co., Jackson, Mich., as distributor for pumps in Michigan and Ontario, Canada. As general suppliers, Midway has been selling pumps of Gaso Pump & Burner Mfg. Co. for several years. As distributors, Midway will carry stocks of both pumps and parts for all models operating in the area it serves.

William E. Toombs is promoted

. . . to vice president of the newly organized International Division of Technical Drilling Service, Inc., Midland, Tex. Headquartering at offices in Oklahoma City, the new organization will offer air and gas-drilling services to countries throughout the world. In addition, specialized air-drilling equipment will be made available for purchase in areas where techniques are proven successful.

REGIONAL AREA SALES MEETING of Drilco Oil Tools, Inc., was held recently at Midland, Tex. Attending were, front row, from left: Moak Rollins, Archie Broadrick, Fred Tschirgl, Zane Duff, Gene Wyatt, Bob Kirkpatrick, and Bryan Long. Second row, from left, are: William S. Bachman, sales manager; Dick Norton, J. M. Wigley, Paul Myers, Bessie Faye Andrews, Donald S. Morris, Glenn Chance, Bob Price, and Jimmy Coker. In the top row are, from left: Joe Hibler, Scarbrough Hartley, William R. Garrett, Richard Hull, Troy Squires, Charles Brown, George Shawver, Carl Williams, J. L. Richardson, and Stanley Moore, president.

Dowell forms new department

R. E. Hurst

. . . under the supervision of R. E. (Bob) Hurst, which will be designed to consolidate all customer-oriented technical activities of the company, announces Carl A. Polk, Jr., executive vice president and general manager. Hurst, former district technical manager from Midland, Tex., has been transferred to Dowell's general office in Tulsa. He is a 12-year company veteran.

The department will be made up of three functional groups: (1) technical service, which will continue to be headed by Joe Moran as chief engineer; (2) technical training and development, under the direction of Jim Reed, supervisor; and (3) research and development, also under the supervision of Reed.

Purpose of the new organization is to provide Dowell's district engineers and other district people who are concerned with technical problems with a central point for all of their needs, including information, assistance, problem solving, training, and development.

Thomas O. Thomas is appointed

. . . assistant to the vice president—International Operations of U. S. Industries, Inc. Thomas joined U. S. Industries in 1958 as manager of international operations for Clearing Division, manufacturer of mechanical and hydraulic presses.

Continental-Emsco announces

. . . the retirement of William T. Powell who for the past 4 years was executive vice president in charge of manufacturing and engineering. A native of Sales, Great Britain, Powell joined Emsco Mfg. Co., Los Angeles, in 1937 and became its president in 1952.

In January 1957, when Emsco and Continental Supply Co. consolidated into Continental-Emsco Co., a division of Youngstown Sheet & Tube, Powell moved to the Dallas headquarters as vice president of manufacturing and engineering.

J&L Supply Division assigns six
. . . to new positions in its field sales organization, according to W. L. Wolfe, vice president of sales. L. V. Page, salesman at Casper, has been transferred to Rock Springs, Wyo. J. B. Knauth, salesman at Liberal, Kans., is now assigned to Jones & Laughlin's Oklahoma City sales office. H. R. Long, former store manager at Brookhaven, Miss., has been assigned as salesman at Natchez, Miss.

Louis G. McKnight and John J. Joyce, sales trainees at Perry, Okla. and Hobbs, N. M., respectively, have become salesmen at their same locations. Raymond R. Brown, sales trainee at Houma, La., has been promoted to salesman and assigned to Liberal.

Schlumberger makes 5 changes
. . . in field personnel assignments. S. J. Rusen, sales engineer at Fort Morgan, Colo., has been promoted to manager of that location while H. O. Daniels, field engineer general at Vernal, Utah, has been named Vernal location manager. R. D. Shay, sales engineer at Artesia, N. M., has been transferred to Roswell.

G. F. Horst, senior sales engineer at Midland, Tex., has been moved to Hobbs, N. M., while P. W. Goodlett, senior sales engineer at San Angelo, Tex., has been reassigned to the firm's Tyler, Tex. office.

National Supply Division makes
. . . a series of changes as part of a comprehensive realignment of its domestic oil-field-sales organization. Nationally, six divisional sales organizations were consolidated into four regional units. Eighteen district groups were combined into eight area organizations.

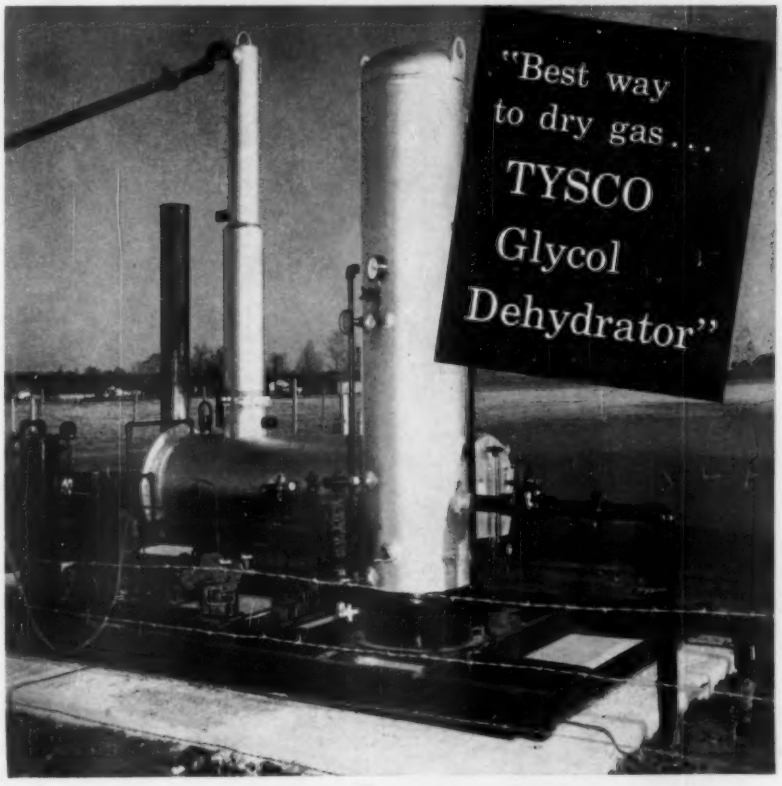
In the western region, changes involve Jess D. McClendon, appointed manager of sales, E. G. Krig, manager of services, and Charles A. Chandler, manager of merchandising. Jerry L. Evans is regional manager. New well-head sales supervisors are Robert B. Hill, southern region, and Robert H. Caldwell, northern region.

Meanwhile, National Supply Co., Ltd., with headquarters at Calgary, appointed R. Wesley Burns regional manager, Brian A. Cooper manager of sales, Glyn A. Hughes manager of services, and E. J. Bird manager of merchandising.

George Henderson to represent
. . . Tyson Smith Co. handling sales and service for the firm's oil and gas - process equipment throughout the Houston area, announces Tom Faver, general sales manager. Henderson's experience in oil - field-equipment sales extends back 7 years and includes associations with Black, Sivalls & Bryson, Graver Tank Co., and Delta Tank Co.

Gordon E. Taylor is named
. . . a senior vice president of Reincke, Meyer & Finn, Chicago-based advertising agency. Taylor joined the agency in 1935 and was made a vice president in 1944. He is a past president of the Chicago Federated Advertising Club.

New valve-manufacturing plant
. . . is now under construction in Alexandria, La., by Manning, Maxwell & Moore, Inc., of Stratford, Conn. Manufacturing is scheduled



A TYSCO Glycol Dehydrator gives you outstanding efficiency in drying gas. It dries more gas—with less glycol. This unit has a low first cost, low operation cost, low glycol loss, and maintenance service is almost nil. Available from stock in 2, 4, 6, and 8 million cubic feet capacities, larger units also available. Pump, filter, and reboiler are oversized so you can increase the capacity of the unit by changing only the tower. Exchangers are in the open, where they can be easily cleaned.

Write for a free brochure containing complete information on the amazing efficiency and economy of the TYSCO Glycol Dehydrator . . .

TYSCO **TYSON SMITH CO.** ONE OF THE SMITH INDUSTRIES

P. O. BOX 7398 • HOUSTON 8, TEXAS

a winch so unusual

we don't know how many uses it has!

here's how it looks inside

here's how it looks on a truck

BRADEN CL WINCH

This BRADEN CL Winch was designed primarily for utilities. It will draw wire or cable at a CONSTANT SPEED until the winch drum is completely filled! *This has not been possible before.*

We believe there are many uses for the new CL Winch. Maybe it will help solve a winching problem for you where CONSTANT SPEED is desirable. Write for complete information on this unusual CL Winch, or let us know if you would like for a representative to call on you. We believe we've really got something.

BRADEN WINCH DIVISION OF MOTOR PRODUCTS CORPORATION

P. O. BOX 547 • BROKEN ARROW, OKLAHOMA

"In Service Around the World"

to begin by the third quarter of the year. The facility will be one-story, about 125,000 sq. ft., and located on a 100-acre site.

Worthington Corp. appoints two ... at the corporation's Standard Pump Division in East Orange, N. J. Robert R. Rhodes has been named manager of sales, and Theodore Davenport becomes manager of planning. Rhodes, a Worthington employe since 1943, succeeds Lewis M. Evans who takes over as eastern regional resale sales manager, marketing division. Davenport, former chemical consultant, is now responsible for the development and acquisition of new products for the division.

Meanwhile, Elliot M. Richman has assumed the job of supervisor of original equipment manufacturer sales, resale sales department, in Worthington's marketing division. In this post, Richman will supervise product sales to more than 2,000 equipment manufacturers in the United States. He has been with the company 13 years.

Duff-Norton names J. S. Kay, Jr. ... as a sales representative responsible for sales of jacks and hoists in southern Illinois, Missouri, and Kansas. The appointment was announced by T. W. Krueger, vice president and general sales manager. Ray goes to Duff-Norton with more than 12 years of sales experience.

Kellogg appoints Robert Kaiser ... to research engineer in the company's research and development laboratories. Kaiser will be a member of the mechanical development group at M. W. Kellogg Co.'s laboratories in Jersey City, N. J.

William H. Jaynes is appointed ... general manager of the Protective Coatings Division, Pittsburgh Chemical Co., according to W. K. Menke, Pittsburgh Chemical president.

Taylor Instrument Cos. assign ... Edward Estess to Kansas City where he will serve as resident representative to cover accounts in that area. Estess was employed by Radio Corp. of America before joining Taylor last August.

ROLO MANUFACTURING COMPANY

P. O. BOX 22126, HOUSTON 27, TEXAS • SALES AND SERVICE OFFICES: DENVER, COLO.; ODESSA, TEXAS; NEW ORLEANS AND LAFAYETTE, LA. • CANADA: PETRO-AUTOMATION INDUSTRIES, LTD., EDMONTON, CALGARY AND REGINA
EXPORT: R. S. STOKVIS & SONS, NEW YORK, N. Y.

The ROLO emblem

on gas dehydrators promises you real efficiency and economy.

Rolo's calcium chloride gas dehydrator gives you *high efficiency*, reducing the dewpoint of outlet gas to a minimum. This efficiency results from combining Rolo's flow design with the dehydrating effectiveness of calcium chloride. Hundreds of Rolo dehydrators are now in the field meeting, and often exceeding, pipeline specifications for water content.

Rolo dehydrators also give you true economy. Both initial cost and operating costs are low. The Rolo design utilizes the low-cost calcium chloride with maximum efficiency. This permits eliminating expensive pumps and regeneration systems, and avoids the costs of daily inspections and maintenance.

Rolo dehydrators can be used over a wide range of gas temperatures, from below 50°F. to above 100°F. They are available in all standard working pressures.

Detailed specifications are available in our special bulletin on Rolo gas dehydrators. Ask your Rolo representative for it, or write to us at the address below.

CORBAN low-cost way to combat well corrosion

Corban® polar-type corrosion inhibitor is offered in 14 varieties to meet and combat both sweet and sour oil and gas well corrosion.

Corban is available in three forms: ready-to-use liquid, concentrated liquid, and sticks 18 inches long and 1½ inches in diameter. Some types of Corban are soluble in oil. Other types are soluble or dispersible in fresh water or brine.

Corban may be applied in any conventional manner, or by the Dowell-developed squeeze technique. Many operators depend on Corban for excellent results with low treating costs. Call your Dowell representative for full information.

PRODUCTS FOR THE OIL INDUSTRY

DOWELL

DIVISION OF THE DOW CHEMICAL COMPANY

AWARDING SAFETY PLAQUES to Helmerich & Payne, Inc., are (from left) George Tribble and T. R. Payne representing American Insurance Group of Dallas. Recipient is Lee Daniel, H. & P. vice president.

Drillers win safety award

TWO YEARS without a lost-time accident on two of Helmerich & Payne, Inc., rigs resulted in an award to the Tulsa drilling firm: Lee Daniel, vice president of H. & P., received the citation for the company's employes from George Tribble and T. R. Payne representing the American Insurance Group of Dallas.

The record was established in the period from October 1958 to October 1960. During this time Rigs 36 and 47 drilled more than 170,000 ft. of hole. Included in the activity was the completion of the world's deepest contract well by Rig 47, the Shell Oil Co. 5 Rumberger, which took over a year to drill and reached 24,004 ft. This Beckham County, Oklahoma, test was a challenge with its high pressure and deep depth. At a depth of 20,000 ft., the slips were carrying more than 320,000 lb. of drill string. Although other new marks were set by the crews that drilled this well, Daniel admitted that the safety record was the one that pleased him most.

A luncheon honoring Rig 36 employes and their wives was held in Woodward, Okla. Officials of H. & P. were joined by insurance representatives and John Wakefield of Marsh & McLennan in feting the crews. A bronze plaque was given to Felix Holmes and Walt Young, toolpushers of Rig 36 during the record period.

At Duncan, Okla., a similar plaque was presented to Roy Clark, toolpusher, and Ray Marsh, district superintendent of H. & P., for the mark made by Rig 47. After the ceremony a dinner was held for Rig 47 employes and their wives.

"Just for the record" prompts comment

FOLLOWING PUBLICATION of the "Just for the record" on this page in the Journal issue of January 30, 1961, p. 217, further comment has been received. These are passed along to the readers.

Word has been received that the 8-hour drilling record should be modified. The old mark of 2,393 ft. set by Assam Oil Co. in Northeast India in 1959 by a 10-man Indian and British crew has been surpassed. The new record is 3,459 ft. in one 8-hr. tour by Mene Grande Oil Co. in El Tigre, Venezuela, where Rig 31 set the new mark in 1960.

! MARTIN RUBBER & DUCK RINGS give excellent life in dirty abrasive fluids . . . high or low gravity . . . much or little water . . . shallow or deep wells. They last for years in the easier pumping wells. Replacement rings cost comparatively little.

! MARTIN PLUNGER BODIES, precision grooved, drilled and threaded (no underneath fluid passage), usually last for years. Tube or barrel costs are often cut in half.

! The replaceable SYNTHETIC RUBBER GUIDES in MARTIN CAGES last longer than any metal, and the cushioning of the ball increases your ball & seat life. Results are often truly amazing. (Patent No. 2,591,174)

Write for our new catalog or see it in the Composite (24th Edition). All products sold thru supply companies.

JOHN N. MARTIN
Manufacturer
9 W. BRADY STREET • TULSA, OKLAHOMA

A letter from Paul R. Bueler, petroleum geologist in Golden, Colo., states that a rig of Wytex Service Corp. of Denver actually held the 1956 12-month drilling record for one rig in 1956 with 267,434 ft. This did not come to light until the firm recently reviewed its files.

Bueler continues that in addition to the 267,434 ft. of hole involving the drilling of 52 wells, Wytex drilled 120,214 ft. of hole in the first 6 months of 1957.

An interesting sidelight in that the rig worked in the Denver basin and crossed the Colorado-Nebraska line 17 times during the 12-month period. The rig was moved in excess of 3,100 miles during the drilling of the 52 holes, averaging nearly 60 miles per move.

D. J. McDuffie, Inc., Plaquemine, La. contractor reported its 1960 one-rig footage as 278,307 ft. while drilling 33 wells. Chandler & Simpson of Denver recorded 287,-591 ft. in 1960 in 45 wells. How then do these marks rank in all-time performances? The top ten 12-month drilling records for one rig are as follows:

1. Chandler & Simpson, Denver, 296,342 ft. in 47 wells in 1959. 2. Chandler & Simpson 287,591 ft. in 45 wells in 1960. 3. D. J. McDuffie, Inc., Plaquemine, La. 278,-307 ft. in 33 wells in 1960. 4. Wytex Service Corp., Denver, 267,434 ft. in 52 wells in 1956. 5. C. & S. of Denver, 267,427 ft. in 1958. 6. C. & S., 238,265 ft. in 1957. 7. C. & S., 216,524 ft. in 1956. 8. Garvey Drilling Co., Great Bend, Kans., Rig 17, 169,924 ft. in 1957. 9. Garvey Drilling, Rig 19, 159,915 ft. in 1957. 10. Russian (unnamed) drilling crew, 128,572 ft. in 1957.

Another point of note was received from William T. Murphy, II, president of Murco Drilling Corp. of Shreveport, who advises that his firm drilled 100 straight producing wells during 1960. Two rigs were involved in drilling these wells during a 10-month period while drilling 240,000 ft. of hole. Although the footage isn't a record, a string of 100 straight successful tests may be a new mark. How about it?

Another year and rechecking of past performance may bring to light new peaks of performance that may be world records. With all the marks to shoot for, your firm may be among the top.

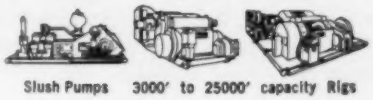
Get the facts about
WINCHMOBILE JR.

Wilson

Before you buy get the facts on light weight . . . low cost . . . long life Winchmobile Junior with the cross mounted engine which saves moving parts and increases hp to the drum by 15%!

WILSON MFG. CO., INC.
Wichita Falls, Texas • The Home of RED IRON

Winchmobiles Traveling Blocks Speedwinches



Slush Pumps 3000' to 25000' capacity Rigs

soltex*

A NEW AND REVOLUTIONARY "FIELD-PROVEN" DRILLING MUD ADDITIVE!

From the developers of Driscose, the original CMC, now comes SOLTEX! A black, free flowing, flake material . . . SOLTEX is a modified, high molecular weight hydrocarbon compound that is soluble in both oil and water. It offers all these outstanding benefits:*

Stabilizes Shale Sections—The addition of SOLTEX has already corrected or prevented shale troubles in many wells. One Louisiana offshore well had drilled into salt and two attempts to deviate the hole with whipstocks failed because of sloughing shale and thick wall cake. After adding 5 lbs./bbl. of SOLTEX to the system, no further hole trouble was encountered and a 30° deviated hole was successfully drilled from the third whipstock to final T.D. In addition to controlling shale, the torque and drag of the drill pipe was reduced.

The Anahuac Shale in the Texas Gulf Coast area is noted for causing trouble. Recently, on a well drilled near Hitchcock, Texas, the usual difficulties expected from "shale balling" were avoided by adding 5 lbs./bbl. of SOLTEX to the mud before drilling into this shale section. The well was completed without incident.

Inhibits Dispersion of Drilled Solids—Laboratory data and field experience show that the effects of solids build-up of muds containing SOLTEX is lower than for other types of muds. Even muds with inhibited filtrates are improved. This results in less jetting and reduces the need for chemical treatment which makes possible more savings.

SOLTEX Protects Against Clay Solids

	Concentration lb./bbl.	Total Bentonite Added, lb./bbl. 0	20	30
		(Plastic Viscosity/Yield Value)		
Base Mud—	0	2/0	13/9	41/62
SOLTEX—	10	3/0	9/4	17/16

Replaces Oil In Many Muds—Geologists are sometimes handicapped by staining and fluorescing caused by oil in the mud. Replacing oil with SOLTEX in such muds provides a dull yellow fluorescent background for an easily recognized reference.

The use of SOLTEX as a replacement for oil also provides other benefits. For example, in the Alta Loma Field, Galveston County, Texas, wells drilled to a T.D. of 12,000′ normally use from $3,000 to $6,000 worth of diesel oil. On one such well drilled in this field, $5,678 worth of SOLTEX was used to replace oil. This offset the cost of diesel oil *plus* an additional $2,000 to $4,000 worth of shale control material that ordinarily would have been used. Also, indirect savings resulted from better control of fluid loss and flow properties.

Increases High Temperature Resistance—In most drilling muds, extreme high temperatures create problems in controlling viscosity, gel, and water loss. SOLTEX mud systems allow more exact, trouble-free control of these properties at high temperatures and pressures.

SOLTEX in High Temperature Mud

Concentration lb./bbl.	Initial AV (a)	Initial WL (b)	10 Hrs at 300°F AV	10 Hrs at 300°F WL	10 Hrs at 300°F Bos (c)	300°F—500 psi Test WL	300°F—500 psi Test Cake
0	37	8.4	44	10.2	700	19.6	5/8
4	39	6.4	35.5	6.6	NM	NM	NM
6	37.5	5.6	35.5	6.0	350	10.9	1/4
8	37.5	6.0	35	5.2	NM	9.0	3/16

(a) Apparent Viscosity (b) Water Loss (c) Boshears-Unit Measure of high temperature gelation. NM—Not Measured.

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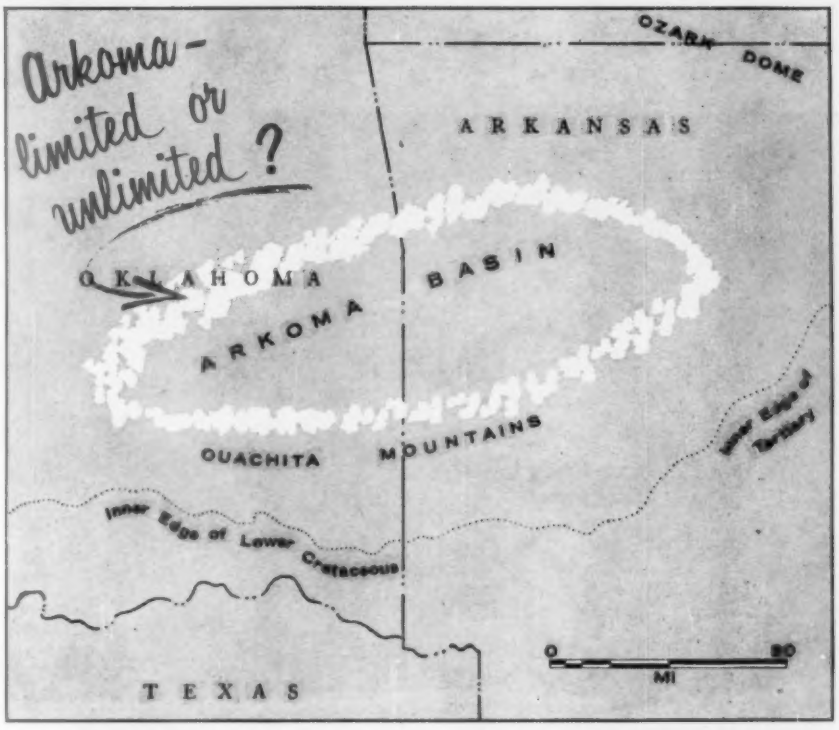
Geologists differ on Arkoma's future

BY JOHN C. McCASLIN
District Editor



SOUTHEASTERN OKLAHOMA'S gas future is brightening despite tough drilling.

THE ARKOMA BASIN is a challenge to exploration men. Over 200 geologists met in Norman last week to hear 14 papers dealing with this highly complex and paradoxical basin of southeastern Oklahoma and western Arkansas. All came away from this Oklahoma University geological symposium convinced that much drilling is yet to be done before Arkoma's true worth can be determined.

Arkoma's situation can be summed up in a statement by Bill O. Andress, president of the Tulsa Geological Society: "Two shoe salesmen were sent to Africa to look over the shoe needs there. One wired the home office that nobody wore shoes, so the market was limited. The other wired back that everybody was barefooted, so the market was unlimited."

Some geologists hold great respect for the basin's future as an important gas province. Others are a bit hesitant to put their toes into the water. All agree that the going will be rough; others ask "What new basin hasn't had a tough time getting started?"

A few gas-reserve estimates were tossed around. Total gas reserves in Arkoma point to 1½ trillion cubic feet. Another estimate was 450 M.c.f. per acre-ft., based on present production. Future exploration and subsequent development may change all this.

A long but quiet campaign . . .

has been under way in Arkoma since 1902. Gas was first found in Arkansas at Mansfield in the Atoka Pennsylvanian. Oklahomans found their first Arkoma gas in 1910 in the Hartshorne sand at Poteau. Both of these fields are still producing.

The road up was long and slow. Discoveries went by almost unnoticed until 1960. Then, Midwest Oil Corp. et al. drilled 1 Raymond Orr in Latimer County, finding gas in the Red Oak and Spiro sands. The well flowed 17 M.M.c.f.d. from 7,193-7,330 ft. and 18 M.M.c.f.d. from 11,514-80 ft.

This discovery found its gas about a mile deeper than previous Arkoma wells, assuring the long-awaited deep trek that will eventually see testing of every major anticline in the southern part of the basin.

Another wildcat that pushed Arkoma on its way to gasdom was Sinclair Oil & Gas Co. 1 Reneau, south of the Choctaw fault at Potato Hills in southern Latimer County. Flow here was 1,850 M.c.f.d.

Ambassador Oil Corp. and Apache Oil Corp. developed additional gas reserves at Northwest Kinta field in Haskell County, and opened Wilburton field in Latimer County. Humble added two gas finds near Pine Hollow in Pittsburg County. Mobil Oil Co. got gas in two zones at 1 Quinton, Haskell County. The well flowed 7,460 M.c.f.d. from Spiro Pennsylvanian at 5,863-5,920 ft.; 3,680 M.c.f.d. from Cromwell Morrowan Pennsylvanian at 6,305-33 ft.

Pushmataha County, deep in the Ouachita Mountain province, got its first production at Stephenson-King-Stevenson Oil Co. 1 Brame. This well, moving gas into a gasless region, flowed only 500 M.c.f.d., but its geological importance is great.

Greater drilling density . . .

and deeper exploration have resulted in 13 active wells in the Oklahoma portion of Arkoma basin. All of these wells, some of them wildcats, are the first of a much-needed increase in deep drilling in the basin. Arkoma has plenty of sands to shoot for. Most of the geologists at Norman agreed that exploration will pick up in the next few years. The basin's many drilling obstacles will undoubtedly be eased.

Three big problems face today's drilling—slow drilling in Arkansas, caving in lower Atoka shales in Oklahoma, and the low density of drilling on both sides. Arkoma has joined the list of daring basins—its predecessors were Delaware, Anadarko, and Paradox.

Drilling of dry hole stirs Oregonians' interest

OREGON recently recorded its ninety-third dry hole since drilling first began in this Pacific Northwest state back in 1902. Humble Oil & Refining Co. 1 Leavitt, about 4 miles south of Lakeview in Lake County, was dry and abandoned February 20 at total depth of 9,579 ft. The well was in basalt when total depth was reported. This was a projected 10,000-ft. pre-Tertiary test, and the second well by Humble to evaluate its 500,000-acre Lake County, Oregon, and Modoc County, California, lease block.

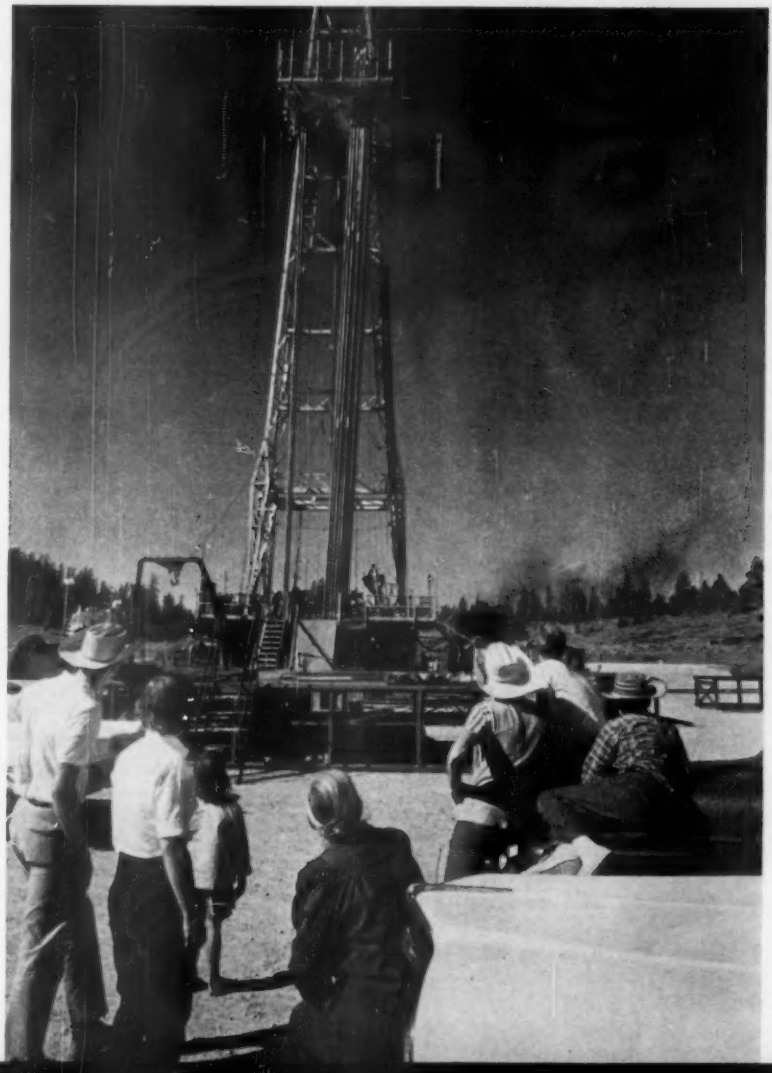
Humble's first wildcat for Oregon was drilled last fall at Grasshopper Flat in the Fremont National Forest. Location was north of Lakeview. It was completed dry in October. Study began in 1953. Humble began looking into the prospects of Oregon as an oil-hunting ground 8 years ago. Company geologists spent the next years poring over data taken from field-trip samples, photographs, and by geophysical means. Humble spent most of its time in eastern Oregon—the area from the crest of the Cascade Mountains to the Idaho border. Oregon's complex geology and geography combined to make Humble's task a difficult one. Far-ranging field trips did bring in a large amount of geologic information, however. When all of the region had been studied, Humble decided to spend its time in the south-central part of Oregon. In 1958 the company began a leasing program. This campaign was as difficult as the geologic hunt earlier. By May of 1960 Humble had all but com-

LOGGING TRUCK passes Humble Oil & Refining Co.'s Thomas Creek wildcat, the firm's first test in Oregon.

Photos and information courtesy Humble Oil & Refining Co.

HOW DEEP ARE YOU, and how soon will you hit oil? These two questions were the most asked by the many daily visitors to Humble's wildcat in Lake County, Oregon. Here a Humble geologist uses visual aids to brief visitors.

LOGS and well cuttings are studied regularly by company engineer and geologist.



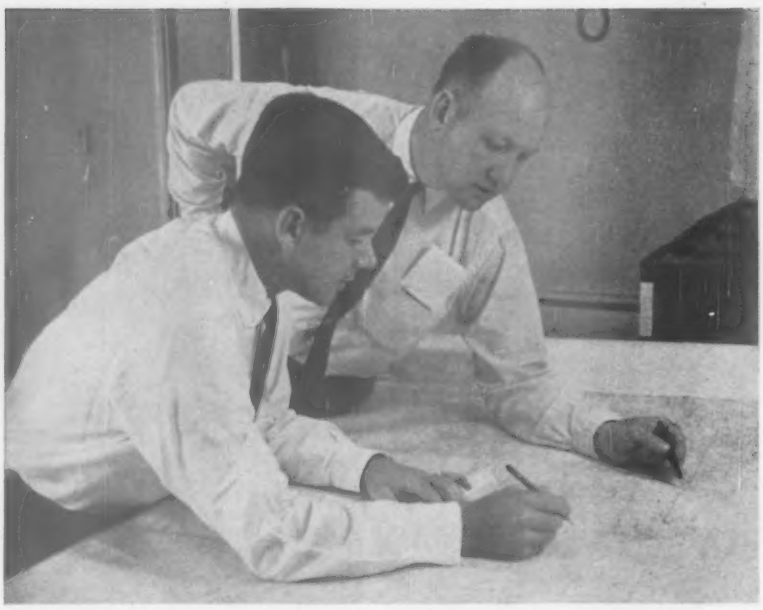
A PARKING LOT was built for the convenience of the many visitors to Thomas Creek.

pleted its leasing program. A wildcat was then planned for the large unitized tract in Lake County—Thomas Creek unit, Block 3. Well site was 22 miles north and west of Lakeview. Drilling began last July. Nearest production of any kind was 560 miles northwest, 250 miles to the south, and 500 miles to the southeast.

Local interest high. Drilling of the Thomas Creek wildcat created lots of local interest as do all wildcats in nonproducing areas. After 3 months of drilling, the well was stopped at 12,093 ft. with no shows.

Washington. Humble also is active in Washington. The company plans to drill a 4,000-ft. upper Eocene test in the Chehalis basin, 23-13n-1e, Lewis County.

The well site is 8 miles east of Selburn-Washington 1 Wultz, a dry hole in 29-13n-1w. Minor oil shows were found in this wildcat which went to 6,500 ft. The new test is the 1 Everett Trust & Savings Bank Trustee. It is the second of Humble's reported several well strat test programs for Chehalis basin.



HUMBLE'S LAND MEN had as hard a job with leasing southern Oregon as the company's geologists did in collecting predrilling data throughout the region.

Disappointments mar Canadian successes

AS MANY oil and gas exploration companies ponder the advisability of making another start in their wildcat play in northeastern British Columbia and the Northwest Territories with spring on its way, a quick glance at the drilling carried out to date reveals a fair share of disappointments plus a degree of exploration success.

One of the biggest disappointments these past few months must be the Celebita Lake gas play under the direction of Home Oil Co. Other areas that held promise of significant gas reserves that have been tempered by recent operations include the Petitot River, Kotcho Lake, and Clarke Lake regions north and northeast of Fort Nelson, B. C. Only a percentage of the hoped-for drilling program has been possible in this region this season. Coupled with an extremely late start in operations due to late freezeup is the early breakup now expected this spring. Two to three holes planned in a number of areas will not be possible this season. Operators must now wait until next fall.

March. March in northern Canada is usually a very favorable operating period. This year's warm winter has caused consternation among operators. Already, drilling contractors are writing climate clauses in their contracts calling for down time on rigs should their equipment be trapped when access roads and trails become impassable.

Celebita Lake. This Slave Point Devonian gas discovery, recorded early in 1960, has come up with a pair of dry holes this season. A third test may be drilled north and west of the discovery well if weather permits.

Petitot River, a Western Natural Gas Co. discovery of late, has also come up with a dry offset this winter, as have both Kotcho Lake and Clarke Lake.

Current wells. Two potentially significant gas discoveries in northern British Columbia and one strike in northern Alberta could well lighten the gloom. The new B. C. gas finds are at Pacific Petroleums and Associates d-33-I Peejay, 60 miles northeast of Fort St. John, and at Hudson's Bay-Union Oil Co. c-39-I Alder in the Beatton River-Milligan Creek area, 70 miles northwest of Fort St. John. Alberta's new find is at Union's Zama Lake wildcat, 180 miles north and east of Fort St. John. The fourth play that may or may not turn out to be important is at Cutbank River, 45 miles south of Grande Prairie and 225 miles northwest of Edmonton.

Peejay. This discovery flowed gas at about 3 M.M.c.f.d. from Gething. The "D" zone of the Triassic in the general area has previously produced both gas and oil. The well is being deepened to lower pays. Drillstem test at 3,310-59 ft. flowed gas. Nearest "D" zone gas is about 1½ miles north of this new find and a Triassic "D" zone oil completion lies about 4 miles southeast.

Alder. This wildcat found its gas in the Triassic "A" zone. Test got about 2 M.M.c.f.d. from 3,478-94 ft. Beatton and Milligan Creek fields, both producing from Triassic "D" oil zone, are 6 miles west and 5 miles southwest, respectively.

Zama Lake. Slave Point Devo-

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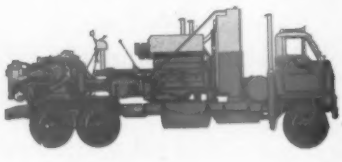

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nian is the pay at Union's 4-14 Zama Lake wildcat in Alberta. Gas flowed at 10 M.M.c.f.d. during tests at 5,114-46 ft. Slave Point gas lies 70 miles northwest of here at Kotcho Lake.

Cutbank River. Regent-Baysel et al. 7-33 Cutbank River is having drilling troubles. Crew lost circulation and have drill pipe stuck in the hole. It was decided to cement the bit at bottom and seal off the formation. Later operators will whipstock past the bit back to the pay zone.

Saskatchewan well has good oil flow

MISSION CANYON Mississippian oil flowed at the hourly rate of 25 bbl. at Kissinger Petroleum Ltd.-Imperial South Carievale 3-4, a wildcat in Saskatchewan. Location is 600 ft. north of the border.

The apparent success is on acreage farmed out by Imperial Oil Ltd. Location is on LSD 3, 4-1n-31w1. A southwest offset in Renville County, North Dakota, has been staked by Clyde Kissinger at 1 State, Lot 4, 28-164n-84w. Location is about 4 miles northeast of Sherwood field. The northeast limits of this field are dotted with dry holes and no drilling has been done between them and the Canadian discovery. If successful, this would be the first such producing area along the border, although many fields in the region come up to the border before playing out either to dry holes or no drilling.

Gas well completed between Wyoming fields

A gas-condensate discovery is reported between Trail and Canyon Creek fields in Sweetwater County, Green River basin, Wyoming. The well is Kirby Royalties and Kilroy Co. 1 Government, SW SE 24-13n-101w.

The well flowed 23 M.M.c.f.d. and 230 bbl. condensate per day from perforations in eight intervals of the Rock Springs between 6,710 and 6,848 ft. Location is in the center of an undrilled 3-mile gap between the southern Sweetwater County fields.

Oil discovery reported in Kansas' Lane County

Western Kansas has an important oil find in the mill at Pet-Ex 1 Edmundson, 6½ miles southwest of old North Fork field, now abandoned, in C NW NW 33-18s-30w, Lane County.

A drill-stem test at 4,361-78 ft. in the Marmaton Pennsylvanian got 750 ft. of free oil and 700 ft. of gas. A test at 4,383-4,446 ft. got 20 ft. of oil-cut mud. A test at 4,535-71 ft. got 15 ft. of oil-specked mud. This company earlier this year gave the county its second oil field at 1 Leighton in C SW NE 28-16s-27w, 11 miles northeast of Dighton. That well, opener of Pendennis field, swabbed 15 bbl. of formation oil hourly from Lansing-Kansas City perforations at 4,200-4 ft.

Rawlins County. Empire Drilling Co. opened Lansing-Kansas City production 3½ miles southeast of Achilles in northwestern Kansas at 1 Schmahl, NW NW NW 9-5s-31w, 11 miles southeast of Waterman field. Drill-stem test at 4,135-73 ft. got 60 ft. oil-cut mud, 250 ft. very heavily oil and gas-cut mud, 50 ft. of clean oil, and 120 ft. of gas in the pipe.

Several strikes brighten picture in Kansas' Barton

DEVELOPMENTS in Barton County, Kansas, include several important well successes. Colorado Oil & Gas Corp. opened conglomerate sand production in new Southeast Erna Lansing-Kansas City Pennsylvanian field, 6 miles northwest of Great Bend in SW NW SE 29-18s-14w.

The 1 Russell "C," second well in the field, got 1,805 ft. of free oil and 5 ft. of filtrate water during a drill-stem test at 3,483-3,515 ft. Southeast Erna field's discovery well, 1 Russell "B," NE SE SW 29-18s-14w, is being completed after making 50 bbl. of oil in 2 hours from perforations in the Lansing-Kansas City at 3,338-92 ft.

Colorado is also completing at 1 Dyer, 1 mile northwest of the above wells. This new Erna field offset, NW NE NW 30-18s-14w, got 165 ft. of heavily oil and salt water-cut mud and 60 ft. of gas in the pipe during a drill-stem test in the Arbuckle Cambro-Ordovician at 3,529-144 ft.

Peel-Hardman Oil Operators are at 3,590 ft. at 2 Dyer "A," another Erna offset in SE SE NW 30-18s-14w. Erna field was opened in February at 1 Dyer in NW SE NW 30-18s-14w. That test pumped 108 bbl. of oil per day from Arbuckle at 3,522-30 ft.

Southeast Redwing. Nadel & Gussman confirmed production in Southeast Redwing field, 5 miles east of Hoisington, Kansas, at Eveleigh "B," S½ SE SW 5-18s-12w. The well is going on pump after making 1 bbl. of oil per hour, natural, from open hole in Arbuckle at 3,345-48 ft. After acid, the well swabbed 5½ bbl. of new oil per hour for 6 hours. This field was opened in December at 1 Eveleigh "B," N½ NE NW 8-18s-12w. Discovery well made 135 bbl. of oil per day from open hole at 3,351-55 ft.

Southern Oklahoma's Southwest Enville field extended northwest

A prolific field in southern Oklahoma's Marietta basin, Southwest Enville, Love County, added a big northwest gas-condensate extension. The well is Texaco Inc. 1 Thomas in C SE SE 1-7s-2e. Open flow was 58,476 M.c.f.d. from Oil Creek Ordovician sand at 8,355-8,410 ft. Well also made 161 bbl. of condensate in 12 hours through 12/64-in. choke. Fluid volume was 72 bbl. per million feet of gas.

Northwest Oklahoma. Pan American Petroleum Corp. completed 1 Purdum in C NE SW 3-22n-25w, 4 miles south of Chaney gas field in Ellis County, flowing 2,930 M.c.f.d. from Morrow Pennsylvanian perforations at 8,668-70 ft. Calculated open flow was 3,400 M.c.f.d.

Morrow gas flows at western Oklahoma wildcat

Gas is reported from Morrow Pennsylvanian sand at 1 Graft-Burmah in C SE NW 18-15n-17w, Cus-

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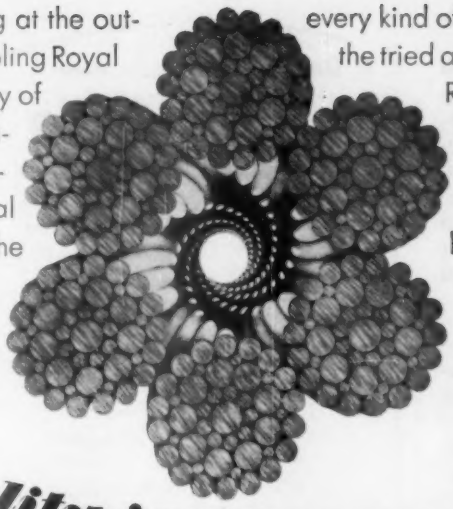

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ter County, western Oklahoma wildcat.

The well, opening Northwest Anthon field, has gas already in two sections of Meramec Mississippian lime. From Morrow at 12,240-66 ft. the well flowed 4 M.M.c.f.d. through ¼-in. choke. From Meramec at 13,966-90 ft. the well flowed 6,500 M.c.f.d. From Meramec at 14,761-14,818 ft. the well flowed an estimated 7 M.M.c.f.d.

Homestead. Pan American Petroleum Corp. extended North Homestead field in Major County 1 mile south into Blaine County, western Oklahoma. The 1 Reames unit-B C NW SE 33-20n-11w, flowed 15,900 M.c.f.d. from Chester Mississippian lime in open hole at 7,359-7,411 ft. Another well is drilling at 1 Hendricks in C NW SE 20-20n-11w, north of the area.

Southwest Enville field. Texaco Inc. completed another big well in Southwest Enville field, Love County, Marietta basin, southern Oklahoma.

The 1 Thomas, C SE SE 1-7s-2e, flowed 21,250 M.c.f.d. and 75 bbl. of condensate per million from Oil Creek perforations at 8,355-8,410 ft.

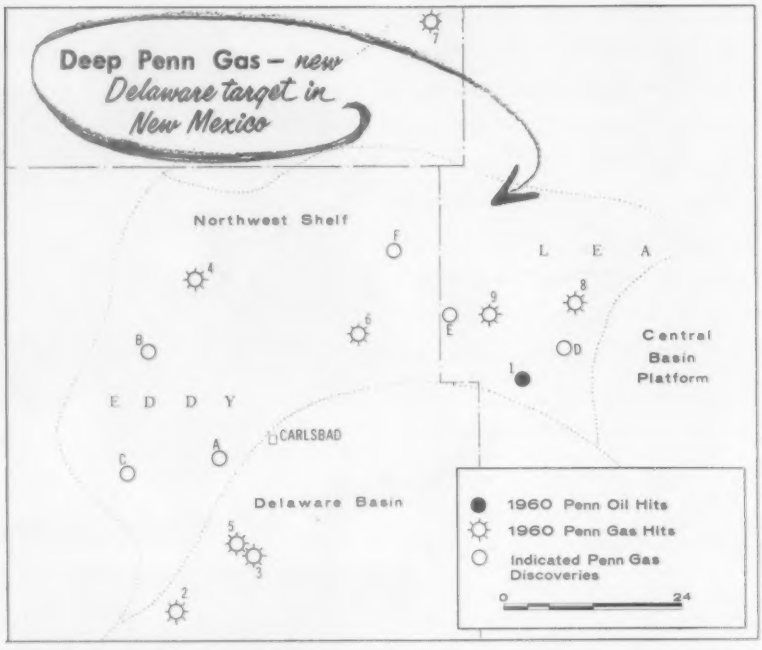
Oklahoma's Cleveland adds significant triple producer

One of the important oil finds of 1961 in Oklahoma is Anderson-Prichard Oil Corp. 1 Navy in NE SW SW 5-8n-2w, Cleveland County.

The discovery is a triple producer in Bromide, McLish, and Oil Creek Ordovician sands. From Bromide at 8,022-27 ft., the well flowed 90 bbl. of oil in 5 hours on 1-in. choke. From McLish at 8,444-54 ft., the well flowed 185 bbl. of oil in 8 hours through 24/64-in. choke; and from Oil Creek at 8,759½-60½ ft., the well flowed 53 bbl. of oil in 7 hours on ¼-in. choke.

Second well. The 3 Navy in NW SE SW 5, cored ahead after shows on drill-stem test at 8,052-64 ft. in the Bromide. Operator is fishing at 2 Navy in SE NW SW 5.

This promising new pool apparently adds another rich Ordovician field to Cleveland County's already-bulging coffer of such reservoirs.



SOUTHEAST NEW MEXICO'S shelf area is enjoying big gas success. Nine new fields last year and half a dozen prospects this year tell the story.

New Mexico gas area grows

SOUTHEAST New Mexico's portion of the vast Delaware basin is fast becoming a Pennsylvanian gas reality—an area that could well turn into another northwestern Anadarko.

Nine new pools. There were nine Pennsylvanian gas and oil discoveries in the Lea-Eddy-Chaves County region last year. So far this year half a dozen wildcats have become new Pennsylvanian prospects for this fast-moving play.

...1 on map. Texaco Inc. 1-CH State of New Mexico, 26 miles southwest of Monument, 36-20s-32e, flowed 49 bbl. of oil per day through 22/64-in. choke on completion. Gas volume was 1,413 M.c.f.d. Pay was Atoka Basal Pennsylvanian at 12,640-54 ft. The well also flowed 114 bbl. of oil per day through 1-in. choke from the Morrow sand at 13,242-66 ft. GOR was 30,931:1. This discovery, completed last April, is 4 miles southeast of Halfway field and 5 miles southwest of Teas field.

...2 on map. Superior Oil Co. 1-134 Government-Federal, 25 miles southwest of Malaga in 12-26s-24e, flowed 347 M.c.f.d. from Atoka perforations at 7,452-78 ft. The strike is in far-distant portion of the basin with no nearby production. Location is 12-26s-24e.

...3 on map. Union Oil Co. of California 2-27 A. J. Crawford, 13 miles southwest of Malaga in 27-24s-26e, flowed 7,200 M.c.f.d. from perforations in the Morrow sand at 11,188-11,212 ft. Location is 1 mile west of Crawford Pennsylvanian field.

...4 on map. Ohio Oil Co. 1 Andrew Arnquist-State, Eddy County, 1 mile southwest of Dayton in 29-18s-26e, 2½ miles west of Dayton field, flowed 545 M.M.c.f.d. from Bend Pennsylvanian at 9,060-9,120 ft., one of the biggest gas wells in the entire region.

...5 on map. Gulf Oil Corp. 1-AD Estill, 15 miles west of Malaga in 29-24s-26e, flowed 46,857 M.c.f.d., and was 4.2 bbl. condensate per million cubic feet of gas, from Pennsylvanian perforations at 9,806-16 ft. Location is 3 miles southwest of Black River field.

...6 on map. Sunray Mid-Continent Oil Co. 1-Q New Mexico State, 11 miles northeast of Carlsbad in 32-19s-29e, 2½ miles southeast of East Millman field and 3 miles northeast of Russell field, flowed 700 M.c.f.d. from Atoka

perforations at 10,886-10,908 ft.

...7 on map. Robinson Brothers Oil Producers 1 Manry Elliott, OWWO, 7 miles southwest of Caprock in 22 - 11s - 31e, flowed 10 M.M.c.f.d. plus 50 bbl. condensate per million cubic feet of gas, from Morrow perforations at 10,867-10,900 ft. Location is in the far northern reaches of the northern shelf, 3½ miles southeast of Apache Springs field.

...8 on map. Ohio Oil Co. 1 State-NPA, 15 miles northwest of Monument in 6-19s-35e, 6 miles south of Vacuum field, flowed 3,750 M.c.f.d. from perforations at 11,-033-73 ft. in Bend.

...9 on map. Pan American Petroleum Corp. 1 West Tonto Deep unit-federal, 13 miles south of Maljamar in 18 - 19s - 33e, flowed 2,030 M.c.f.d. plus 31 bbl. condensate from Morrow perforations at 13,325-78 ft.

New discoveries. With last year's successful Pennsylvanian campaign behind it, Southeast New Mexico is deep in the same play this year.

Honolulu Oil Corp. is reporting 10,500 M.c.f.d. from Morrow at its 1 McKittrick unit wildcat in central Eddy County. Flow is from 11,192-11,257 ft. Location is C W½ SW NE 25-22s-25e, 24 miles south of Atoka gas field, 11 miles north of new White City Pennsylvanian gas field. Location is 12 miles northeast of Morrow gas production at Bandana Point unit, a Humble operation (A on map).

Another new Morrow discovery is George R. Brown 1 Humble in C NE SE 17-20s25e. Location is southwest of Atoka field and northwest of the Honolulu discovery. Tests got 2,447 M.c.f.d. from 9,324-9,441 ft. Various other drill-stem tests also got Morrow gas (B on map).

At (C on map) Humble 2 Bandana unit, 3 miles northwest of the field in C NW NE 2-23s-23e, is below 11,489 ft. Both gas and oil have shown on drilling, but no tests have been run.

Southwestern Lea County is also in the drilling spree. U. S. Smelting 1 Federal, C E½ SE NW 11-20s-34e, (D on map), flowed 7,334 M.c.f.d. on drill-stem test of Morrow at 13,018-13,109 ft. Drilling is below 13,220 ft. This well is on the northwest offset to the Bandana unit No. 1 discovery.

A confirmation well is due at El Paso Gas 2 Lusk Deep unit, ½ mile northeast of the discovery well, a Bone Springs and Strawn oil strike. Drilling of the No. 2 well in C SW SE 18 - 19s - 32e got 12 M.M.c.f.d. during Morrow tests at 12,376-12,424 ft. On ¼-in. choke the well made 4 M.M.c.f.d. and 3 bbl. condensate per hour (E on map).

In Eddy County, El Paso State No. 1, an Odessa Natural Gasoline Co. wildcat, flowed 3,600 M.c.f.d. plus 163 bbl. of condensate on 26/64-in. choke on latest test of Pennsylvanian at 11,357 - 71 and 11,448-60 ft. (F on map). Location is adjacent to shallow Premier field production and 2 miles southwest of Cedar Lake Abo oil field, nearest deep production.

Bright prospects. This big push into Pennsylvanian gas reserves isn't confined just to the New Mexico side of the basin. It has been going on in Texas for several months. There are a number of Pennsylvanian fields in New Mexico's portion of the basin, but they have been few and far between. First Pennsylvanian gas on the Texas side was just uncovered last year.

Morrow gas discovery reported in New Mexico

Gas-condensate production is indicated at a wildcat in southwestern Lea County, 15 miles southeast of Maljamar in Southeast New Mexico. The well is El Paso Natural Gas Co. 1 Mescalero unit, a 15,000-ft. wildcat.

A drill - stem test in the Morrow at 13,094-13,237 ft. got 16 M.M.c.f.d. plus 6 bbl. of condensate per hour. Location is in 7-19s-34e, 3½ miles southeast of Buffalo field and 12 miles northeast of the 1 Lusk, an El Paso Bone Spring and Strawn discovery.

Colorado drilling uncovers new gas find

Another gas discovery is reported in the spirited drilling campaign in southeastern Colorado. This section

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of the northwestern Anadarko basin is enjoying a comeback in exploration.

Keith L. Rising, Trustee, et al. completed 1 Burchfield in C NE SW 4-32s-43w, Baca County, Colorado, flow a flow of 2,500 M.c.f.d. Flow is from Topeka Pennsylvanian perforations at 3,245-58 ft. Location is 9 miles west of Greenwood gas field and 4½ miles east of a recent Topeka gas discovery at Horizon Oil & Gas Co. 1-10 Lepel in S NE NE 10-32s-44w. That well flowed 2,225 M.c.f.d. from perforations at 3,324-32 ft. Nearest previous drilling to the new well is 3 miles northeast.

Three new oil pools, one gas pool discovered in Illinois in February

Three new Illinois oil pools, Macedonia in Franklin County, Aden East in Wayne County, and Trumbull North in White County, and one new gas pool, Tilden North in Washington and St. Clair counties, were discovered in Illinois in February.

There was one extension each to Plainview pool in Macoupin County and Harco East pool in Saline County.

A total of 116 wells was completed in the 4-week period. Completions include 60 oil wells and 4 gas wells, a success ratio of 55%. In addition, 8 wells that had previously been drilled as dry holes were worked over and recompleted as producing wells.

Five of the wells completed in February were drilled deeper than 4,000 ft. Three of these went deeper than 5,000 ft. One of the deep holes discovered Macedonia pool in Franklin County. It is the C. E. Brehm-Sun Oil Co.'s 1 Hutchcraft unit 1, in 24-5s-4e. In 1950 this well was drilled to a total depth of 3,304 ft. and completed as a dry hole. Early this year the hole was reopened and drilled deeper to 5,249 ft. It was completed in February with an initial production of 75 bbl. of oil a day from the Harrodsburg lime which was topped at 4,096 ft.

Estimated production for Illinois for February is 5,953,000 bbl.

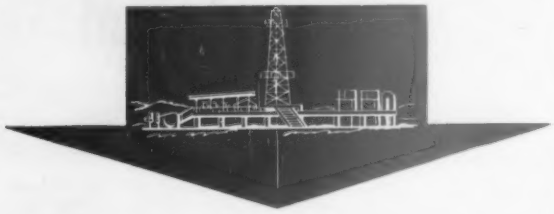
Deep wildcat due in Hardin County, Kentucky

A deep test is being drilled by a group led by Bill Duchscherer on the George Franzell farm in 5-R-43, Hardin County, Kentucky.

Operators plan to test the entire Silurian and Ordovician sections. Location is in an area that has had shallow gas production since 1900, but no deep drilling. Location is on a large anticlinal fold, trending northeast-southwest, and is on the same trend as the Muldraugh gas-storage dome.

Combination oil, gas well completed in eastern Kentucky

In eastern Kentucky, Kentucky West Virginia Gas Co. has completed a good combination oil and gas well at their 1144 Kentucky River Coal Corp. Located on Lotts Creek in Perry County, well initialed for 25 bbl. of oil daily along with 2,348 M.c.f. of gas. Producing formation is the Mississippian Big Lime topped at 1,825 ft.



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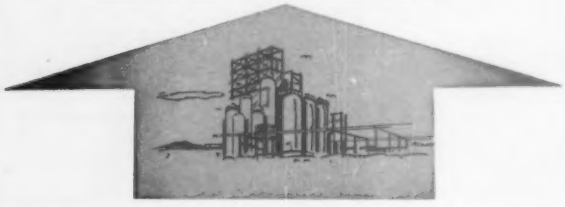

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Kentucky test fails

In Owsley County, Kentucky, a shallow Mississippian test has ended in failure as Hi Knob Oil Co. has abandoned 1 Edna & Arch Bell. Located on White Oak Creek in the Boonville Quadrangle, the well tested the Mississippian Big Lime to a total depth of 842 ft.

Ohio adds Clinton pool

In Ohio's Guilford Township, Medina County, Rixleben, Inc., have indications of a small pool opener in the Clinton sand. Natural shows of oil and gas was found in the sand logged at 3,553-88 ft. Shut-in gage of 2 E. K. Newcomer, Section 28, was 32 M.c.f.d. with 375 psi. after fracture.

Ohio gets new gas strike

In Ohio another good gas producer was hit in southeast Howard Township, Knox County. H. D. Collins 2 John C. Hammond, Lot 16, 4 Qt., had a natural show of gas and oil in the Clinton sand from 2,764 to 3,783 ft. and 281 M.c.f.d. from 2,796 to 2,811 ft. Both sections were fractured and the well was shut-in with a final open flow of 6,090 M.c.f.d. and a rock pressure of 870 psi. in 40 hours.

Mississippian gasser completed in Panhandle's Pshigoda field

Phillips Petroleum Co. 1-C Herndon, a lower Morrow Pennsylvanian well in Pshigoda field, Ochiltree County, Texas Panhandle, was completed flowing 5,610 M.c.f.d. from perforations in the Mississippian at 9,383-9,403 ft. Location is in Section 578, Block 43, H&TC Survey, 15 miles southeast of Perryton. It lies about 1 mile east of Shamrock 1 Edna J. Herndon, Ellis Ranch field.

Dual oil find finaled in Stephens County, Texas

A dual oil discovery is reported 15 miles north of Breckenridge in north-central Stephens County. The well is Harding Brothers 2 S. P. Robertson, 1¼ miles northeast of

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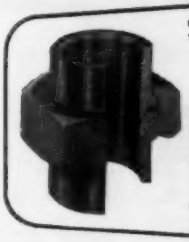

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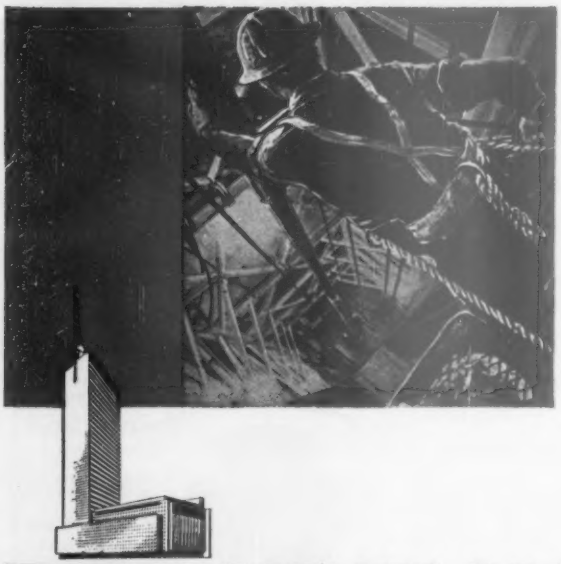

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Bower multipay field in the A. S. Johnston Survey, 56.

Pool opener flowed 95 bbl. per day on 24/64-in. choke from Caddo perforations at 3,564-76 ft. and 394 bbl. per day on 6/64-in. choke from Mississippian perforations at 4,340-76 ft. Operator plans to request commingled state potential. Field name will be either Harbro or or Shasro field.

West Texas. Cities Service Oil Co. completed the second producer in new Block A-41 Ellenburger field, 12 miles southwest of Andrews in Andrews County.

The 1-H Brown flowed 372 bbl. of oil in 11 hours through 26/64-in. choke, or 812 bbl. per day. Production is from open hole at 11,689-11,715 ft. Location is in Section 21, Block A-41, PSL Survey. The well confirms the field's first well.

New reference book now available in Texas

Runnels County, West Central Texas, is featured in the new Petroleum Review by Robert L. Phifer, Phifer Petroleum Publications, Box 6014, Houston. This petroleum review, covering all fields in Runnels County, has 236 pages of pertinent information.

There are many illustrations included in this chronology of fields in the county. There is also a survey map with all fields in the county well illustrated. Production records of each field are also included. This is another in a long series of such reviews of West Texas counties. These books are a valuable addition to those interested in West Texas oil.

East Texas strike tops Pettet pay

New lower Pettet production has been opened in a wildcat discovery 1¼ miles southeast of Danville field in northern Rusk County, East Texas.

Danville field, straddling the Rush-Upshur county line, is productive from both the Pettet and Travis Peak horizons.

The new discovery is by Fred Whitaker at his 1 Compton, completed with a calculated open-flow potential of 2,500 M.M.c.f.d. of gas, making 26 bbl. of 60.4°-condensate. Pay is perforated at 7,451-57 ft. It was treated with 10,000 gal. of acid.

Hole was drilled to 7,600 ft. in Travis Peak. Showings were logged but after casing was run and perforated in this pay, at 7,620-28 ft., it failed to respond.

Drillers try Texas' Saline dome again

ANOTHER ATTEMPT is to be made to tap the so-far elusive oil or gas production on East Texas' large Grand Saline salt dome, in northeastern Van Zandt.

It will be a Travis Peak test on the south flank of the dome by R. J. Caraway. Location of the operation is 1½ miles south of the town of Grand Saline. Objective is expected at 9,450 ft. The test is listed as 1 Fisher.

Grand Saline area was the scene of a recent Rodessa discovery by Humble Oil & Refining Co., but it is considered too far away to be associated with the dome.

Humble's discovery well, 1 Savage is 3½ miles northwest of the town, and about 4 miles from Caraway's new test. It was drilled to salt to a total depth of 13,144 ft., but this was believed to be bed salt. The well was plugged back to 8,377 ft., and completed as a 100-bbl. well through ¼-in. choke in the Rodessa at 8,290-8,300 ft.

That new field has been named North Grand Saline. Humble's second test, 1 Smith, is 4,191 ft. south of the discovery well.

Grand Saline is one of 12 remaining known salt domes in East Texas on or around which no production has been found so far. Production has been found on six known domes.

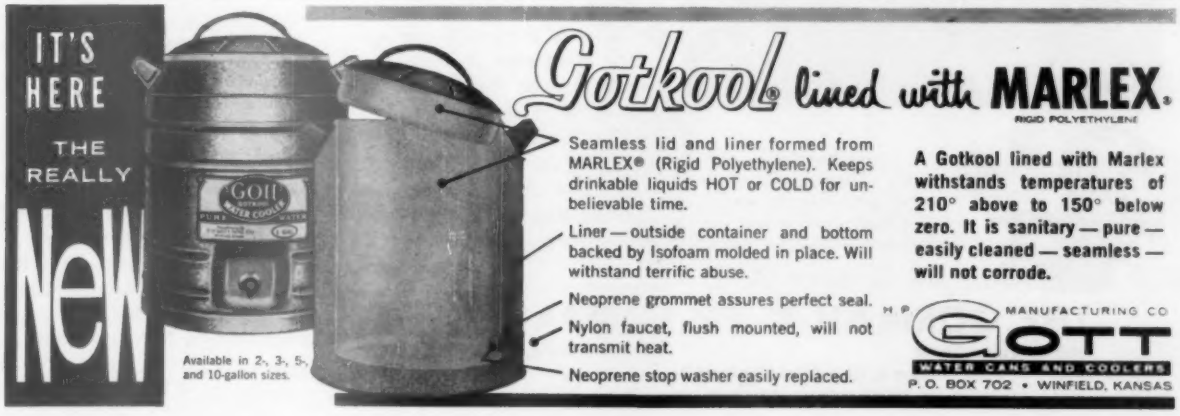
Two flowing wells finaled in Illinois' White County

Two flowing O'Hara Mississippian lime producers were completed by Slagter Producing Co. in White County, 3 miles west of Crossville, Ill.

The 2 Carroll Young, NW SE NW 29-4s-10e, flowed 240 bbl. per day after acid from O'Hara at 3,140-50 ft. The 3 P. L. Barbre, N½ SW SE 20-4s-10e, flowed 50 bbl. per hour in O'Hara at 3,144-59 ft. after recovering load following acid. Now it flows 25 bbl. per hour.

New producer added to East Texas field

One of the latest wells in the New Fairway James lime field in northeastern Anderson County, East Texas, has been dually completed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with a lower Anhydrite stringer as the second pay.

The well, Fairway Operating Co. 1 Wilkerson, previously was reported completed making 217 bbl. of 47.4°-gravity oil daily through 12/64-in. choke from the James at 10,111-25 ft.

From the Anhydrite stringer, perforated at 9,436-52 ft., it flowed 150 bbl. of 40.8°-gravity oil daily through 10/64-in. choke.

This is the first well in the area to be completed in this shallower pay. All previous wells are producing only from the James.

Testing goes on at Williston basin

TESTING continues at Murphy Corp.'s extension well at Tule Creek in Roosevelt County, northeastern Montana, Williston basin.

The 2 Zimmerman, C NW SW 17-30n-48e, flowed 432 bbl. of oil per day on ¼-in. choke from Nisku Devonian perforations at 7,710-14 ft. On 12/64-in. choke, the well flowed 216 bbl. per day. After further acid treatment, the well flowed 540 bbl. per day on 13/64-in. choke, 228 bbl. in 8/64-in. choke. The latest gage reported was 261 bbl. daily through 9/64-in. choke. This well is northeast of the field discovery well and southeast of the 2 Sletvold producer.

There are two locations busy in the field. Humble and Phillips 1 McKee, C NW SE 13-30n-47e, ran drill-stem test at 8,468-8,531 ft. This well earlier flowed oil at 7,631-45 ft. Recovery on the above-mentioned test was 2,675 ft. of brackish water. A third well in the area, Davis Oil Co. 1 Toavs, SE NE 11-29n-46e, is drilling below 6,460 ft. It is a 7,900-ft. Nisku test 9 miles southwest of Tule Creek production. The Humble-Phillips well is a southeast offset to Placid Oil Co.'s recent producer at 1 Lough in SE NW 13-30n-47e.

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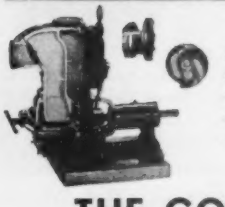

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Action shapes up for offshore Washington

Significant offshore acreage southwest of Ocean City, Grays Harbor County, Washington, was recently assigned to Union Oil Co., according to Northwest Oil Report, Portland.

This move by Union is regarded as a highly significant exploratory step. Assigned leases fall in Sections 32, 28, 33, 29, 19, 18n-12w, and Section 8-17n-12w.

Lewis County. Humble made location for 1 John M. Brown et al. in 15-11n-1e, Lewis County.

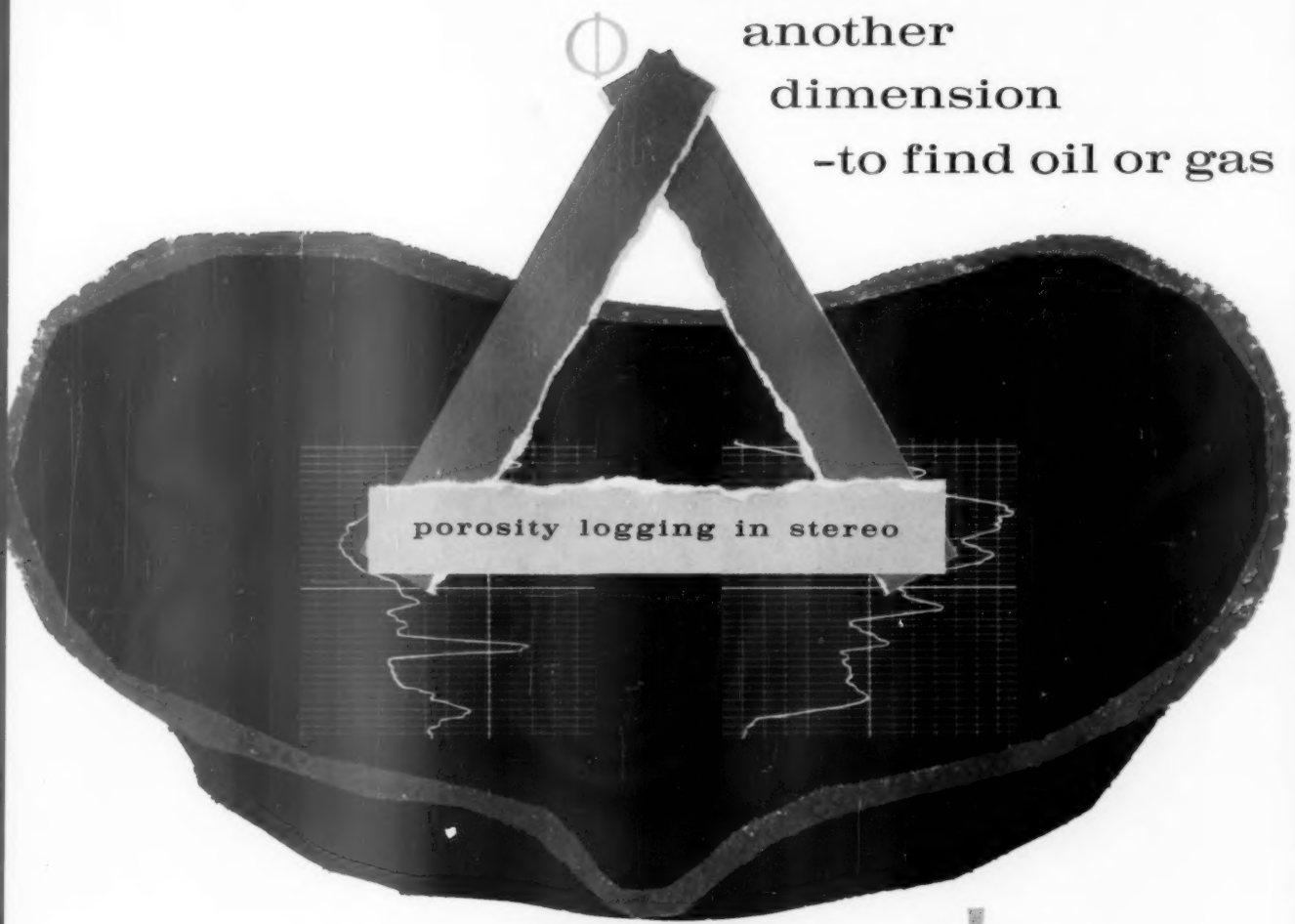
This is a 4,000-ft. Upper Eocene test, 7 miles east of Toledo, Wash. Exploration Drilling Co. of Whittier, Calif., has contract.

New location. Sunshine Mining Co. et al. 1 Beach is a new location in Grays Harbor County, N¼ 22-18n-12w. It will try for Ocean City sand at 3,000 ft.

Dry hole. Humble has quit at its 1 Rosa Meyer in 8-12n-2e, Lewis County. The Salkum area wildcat went to 4,482 ft. It was slated as a 4,000-ft. McIntosh sand test.

In the Onalaska area, Humble 1 Everett Trust and Savings Bank Trustee wildcat, 23-13n-1e, is grading location. It will go to 4,000 ft. or upper Eocene. Location is 3 miles northeast of Onalaska.

look at another dimension -to find oil or gas



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British Petroleum is proud to be associated with the Snowy Mountains Scheme, one of the world's greatest engineering undertakings.

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Southwest Alberta gas reserves grow with new discoveries

THE EXTREME southwestern corner of Alberta can now boast three separate major wet-gas reserves. The most recent of those, and one that has been swaying on the ropes for over a year is that known as Lookout Butte, 7 miles south of fabulous Pincher Greek field and 14 miles southeast of production in Waterton Park field.

It was during the latter part of 1959 that the British American Oil Co., Ltd., drilled the discovery well in the Lookout Butte district. That venture pointed out that a probable wet-gas reservoir had been tapped as it was completed from a 658 gross pay thickness for 31 M.M.c.f.d. plus 94 bbl. of condensate for each million cubic feet.

Development of the field, however, did not start immediately after discovery. The first well began some 6 months later. That test, only 1¼ miles northwest of the original strike, failed to find the productive section as prolific as in the first well and has been standing suspended for some months. In an area which is renown for its 'slips' and 'faults' and lying within that region of Alberta referred to as the Foothills, British American was not disheartened. Therefore, another extension attempt was started 3 miles northwest of the discovery well and 1½ miles north-northwest of the initial followup.

No. 2. That second well is just being completed and while not indicating the same gross pay thickness as the discovery well it appears to be as prolific. Recent flow tests on the well, B. A. 4-13-2-29, Lookout Butte, on LSD 4, 13-2-29w4, have yielded natural gas at rates as high as 22 M.M.c.f.d. and condensate recoveries equivalent to 120 bbl. per million.

Shell Oil Co. of Canada, Ltd., is also flow testing its first attempt in the same district. That venture, Shell 7-20-1-28 Chief Mountain, on LSD 7, 20-1-28w4, 2½ miles southeast of the 11-31 Lookout Butte discovery well, also indicated production during drilling. Flow tests from it have yet to show the potential of either of British Americans', but has nevertheless indicated commerciallity. Latest test available shows the well producing gas at the rate of 6,500 M.c.f.d. and yielding 114 bbls. of condensate, plus 2 of water per million cubic feet of gas produced.

Big gas area. This region of Alberta is already playing a great part in the province's gas industry. Pincher Creek is already tied to gas-export facilities as the Alberta Gas Trunk Line takes the product from that field and delivers it to Trans Canada Pipeline Company Limited for delivery to eastern Canada and the U. S. Midwest. Waterton Park field will be tied into another spur of Alberta Gas Trunk Line later this year when large-scale export to California gets underway. Either of those systems could be extended at very little cost to the Lookout Butte district and as Shell is starting construction of a $20,000,000 processing plant at Waterton that plant or the present British American plant at Pincher could scrub the gas for pipeline delivery.

Between now and the end of the year this general region of the province is going to be one of the major development sectors and will command a great deal of 'big' drilling equipment. As holes range from 10,000 to 13,000 ft. per well the time element is also a major factor in speed of development. British American is already operating three rigs in the district, two at Pincher and one at Lookout Butte, while Shell has three at Waterton and also one at Lookout Butte. In addition to those, Pan American is currently drilling a wildcat test off the northwestern edge of Waterton and Shell recently announced that it has under contract another six rigs which will move to the district immediately.

While British American and Shell are the two main operators in this region Texaco Exploration Co. and Pan American have small land holdings in the area. The British American lands, particularly in the Pincher Creek and Lookout Butte fields are, however, subjected in the large to a gross royalty to a long-time Canadian independent—Calgary and Edmonton Corp., Ltd. That latter company also has optional participating interests and net-carried interests in the same lands.

Offshore test suspended

The first wildcat drilled from a new platform installed on Parcel E off Santa Barbara County, California, has been suspended at 1,545 ft., which is believed well above the pay section of the offshore tract.

Phillips Petroleum Co., operator for Pauley Petroleum Co. and several other partners, reportedly has discovered gas on the block. The pay section is believed to be a Miocene sand between 4,500 ft. and 5,000 ft.

Rather than drill a new hole, Phillips plans to reenter one of 12 core holes drilled on the 3,840-acre tract.

The recently suspended hole is the 14 State 2207. The redrill will be on 4 State 2207, which is located

Canada completions, February

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Alberta	128	57	16	50	5	845,510	247	46	3	5	38	287,953	81
Saskatchewan	38	29	0	9	0	148,217	80	4	1	0	3	14,471	11
Manitoba	1	0	0	1	0	2,620	4	1	0	0	1	2,620	1
British Columbia	23	0	10	13	0	123,033	39	18	0	5	13	97,265	30
Northwest Territories	5	0	0	5	0	19,206	6	5	0	0	5	19,206	6
Ontario	24	8	8	8	0	26,955	43	...	...	...	...	.....	...

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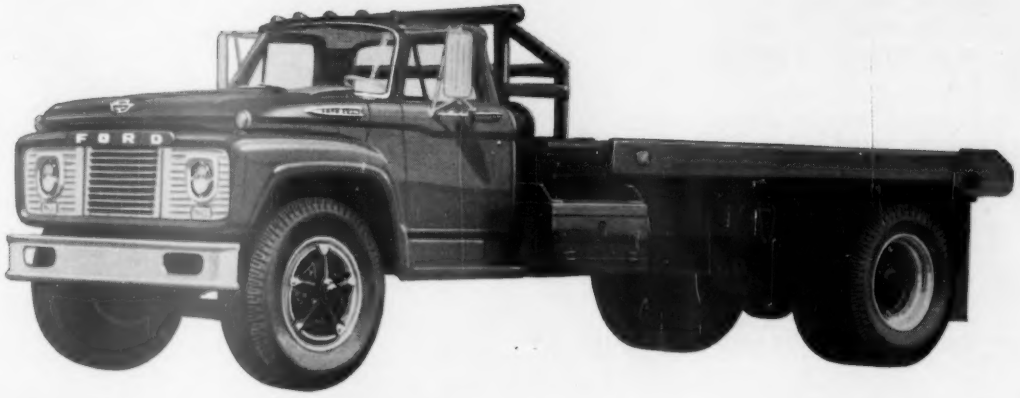

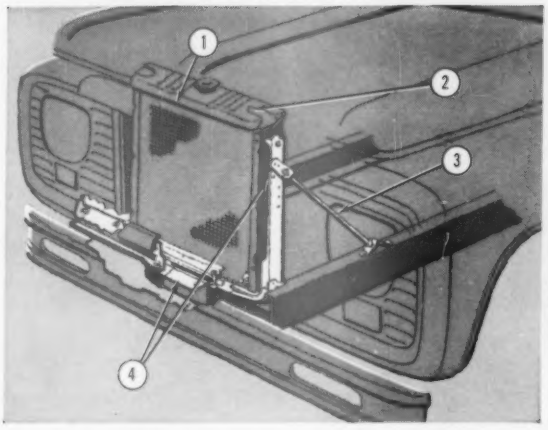

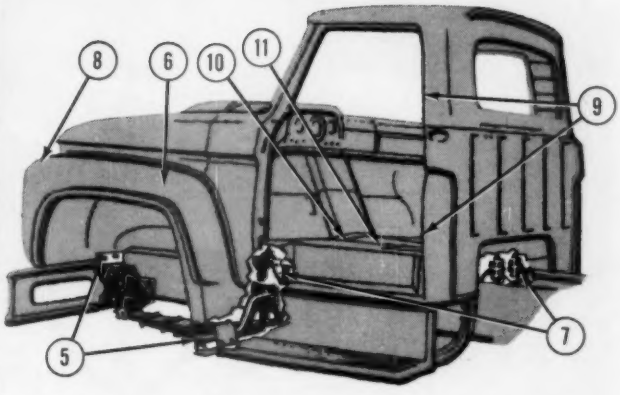

(1) **Save with Ford's exclusive "lock-seam" radiator construction** that doubles the solder area at key seams for greatly increased strength and longer radiator life.

(2) **Save with heavier-gauge metal on radiator tank and header.** Upper and lower tanks and header have thicker walls to resist vibration, jolts and corrosion for greater reliability.

(3) **Save with independent radiator mountings,** separate from front-end sheet metal. This means that road shocks, vibrations and shakes are not transmitted to the radiator through sheet metal . . . tanks, tubes and connections last longer, require less maintenance.

(4) **Save with "horse collar" mounting** seated on rubber pad for extended radiator life. This new mounting on resilient rubber at the center of frame cross member soaks up any frame flexing . . . cuts wear and tear on entire cooling system.

(5) **Save with independent fender mountings.** Fenders are bolted to a rubber-cushioned transverse bracket at the front and a frame-mounted bracket at the rear. This mounting, independent of both cab and radiator, eliminates stress transfers for greatly increased fender life.

(6) **Save with removable fenders.** The quick and easy removal of only 8 bolts per fender provides faster service accessibility to the engine area, saving valuable maintenance time.

(7) **Save with new 3-point cab mounting system** for greater cab durability. Two outboard front mounts plus a centered "twin" rear mount provide a triangular system that holds the cab stationary while allowing the frame to move independently . . . reducing strain on the cab.

(8) **Save with 25% heavier-gauge sheet metal** in fenders, cab floor pan and toeboard for longer life through more strength and greater resistance to corrosion.

(9) **Save with stronger cab construction.** New full-length door pillar reinforcements provide increased cab rigidity, stamina.

(10) **Save with a more solid foundation.** Thicker sheet metal is used in the integral floor pan and toeboard, this with added floor reinforcements gives a stronger, more rigid base for longer cab life.

(11) **Save with new transmission access panel** to cut transmission service time.

FORD TRUCKS COST LESS

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FORD DIVISION, Ford Motor Company

just northeast of the platform. The No. 4 well was drilled to 6,845 ft. before it was suspended September 18, 1959.

Discovery wells

CALIFORNIA

Colusa County:

Occidental Petroleum Corp. 2 Sachreiter, 1,320 ft. north from center of 4-14n-1w. Flowed 13,450 M.c.f.d. through ½-in. choke from perforations at 7,688-7,706 ft., 7,710-22 ft., and 7,786-7,806 ft. TD 7,926 ft. Deep pool discovery of Sachreiter zone (Cretaceous) in West Grimes gas field.

WESTERN CANADA

Alberta:

Amerada Crown-CN 4-21 Rowley, LSD 4, 21-32-20w4. Pekisko oil discovery. TD 4,618 ft. Pan American 16-32 A-1 Melvin River, LSD 16, 32-116-13w5. Slave Point oil discovery. TD 4,066 ft.

Pan Am A-1 14-30 Marten Hills, LSD 14, 30-76-25w4. D1 gas discovery. TD 5,323 ft.

Texaco-Texcan 10-21 Sinkhole, LSD 10, 21-51-9w5. Nordegg gas discovery. TD 6,570 ft.

Cal-Standard 10-1 Meekwap, LSD 10, 1-65-18w5. Notekiwin gas discovery. TD 10,615 ft. Homestead et al. 10-31 Airdrie, LSD 10, 31-26-1w5. Second White Specks oil discovery. TD 8,375 ft.

British Columbia:

Pure-Richfield d-89-D Beatton, 89-D-94-H-2. Gething gas discovery. TD 3,860 ft.

Union-H.B. c-39-I Alder, 39-I-94-H-2. Triassic gas discovery. TD 3,765 ft.

Sinclair-Pacific d-50-A Weasel, d-50-A-94-H-2. Gas discovery. TD 5,323 ft.

Saskatchewan:

Central Del Rio-Canadian Superior 12-25 Frys, LSD 12, 25-7-31w1. Mississippian oil discovery. TD 3,260 ft.

COLORADO

Pitkin County, Wolf Creek unit:

Utex Exploration Co. 1 Cal, NE NW 26-8s-90w. IPF 3,380 M.c.f.d., 2-in. tubing, Cozette 4,658-4,786 ft. TD 5,165 ft. Cozette discovery, new pool.

NORTH LOUISIANA

Claiborne Parish:

Tennessee Gas Transmission Co. 1 J. A. Seegers et al. unit, SE SW SW 3-23n-8w. IP 480 BOPD, 22/64-in., 48°, TP 800 psi., GOR 1,875 cu. ft. per bbl., perf. 9,902-33 ft., Smackover "A" zone; and 207 BOPD, 14/64-in., 48.6°, 550 psi., GOR 1,988 cu. ft. per bbl., perf. 10,338-46 ft., 10,350-57 ft., and 10,360-77 ft., Smackover "C" zone. TD 11,162 ft. Extends Haynesville field 2¾ miles southwest of Smackover production.

NEBRASKA

Banner County:

Marion Oil Co. 1 Olsen, C SE SW 5-17n-56w. IPP 50 BO, 5 BWPD, "J" sand discovery, 6,691-96 ft. TD 6,773 ft.

OHIO

Medina County:

Rixleben Inc. 2 E. K. Newcomer, Sec. 28, Guilford Twp. IPF 32 M.c.f.d., Clinton 3,553-88 ft. TD 3,644 ft. Initial rock pressure 375 psi.

Richland County:

E. C. McManaway 1 Dyol Donough, Sec. 1, Washington Twp., Newburg 2,297-2,314 ft. IPF 1,630 M.c.f.d., natural, 730 IRP. TD 2,314 ft. New gas discovery.

WEST CENTRAL TEXAS

Coleman County:

J. W. Sorrells 1 Mrs. J. A. Miller, 7 miles northeast of Coleman in W. B. Twitty Sur. 721. IPF 97 BOPD, plus 10% water through open 2-in. tubing, 40°, GOR 1,200:1, CP packer, TP 90 psi. Morris sand 2,054-64 ft. TD 2,068 ft. New oil discovery.

Haskell County:

Prorated in Regular field. McGargel Drilling Co. 1 Josie M. Hester, 2 miles northeast of O'Brien in Sec. 48, Blk. 2, D&W Sur. IPF 110 BOPD, 8/64-in. choke, 41, GOR 650:1, CP 275 psi., TP 510 psi., open hole Strawn sand 4,885 ft. TD 4,898 ft. New oil discovery.

Throckmorton County:

Prorated in Regular field. G. E. Kadane & Sons et al. 1 J. H. Thomas, 4½ miles west of Throckmorton in SE¼ Sec. 219, BBB&C Sur. IPF 86 BOPD, 8/64-in. choke, 40°, GOR 370:1, CP 100 psi., TP 375 psi., Caddo lime 4,578-86 ft. TD 5,155 ft. New oil discovery.

WYOMING

Fremont County, Howard Ranch unit:

Shell Oil Co. 23-15 Unit, NE SW 15-39n-93w. IPF 2,163 M.c.f.d., with trace cond., 2-in. tubing, SIP 4,090 psi., Lance 8,318-8,952 ft. TD 11,474 ft. PBTD 11,438, 9,901, 9,052 ft. Lance discovery, new Upper Cretaceous field in Wind River basin.

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SINCE 1895

William S. Spangler . . . he's looking beyond Texas for opportunities.

Automation's in High Favor

. . . with W. S. Spangler, president of Humble Pipe Line, who has been working quietly to modernize his company.

ONE OF THE oil industry's least publicized reorganization and modernization programs has been taking place during the past 2 years in Humble Pipe Line Co. Its executives have tailored operations and corporate structure to the demands of an automated age.

The pipeline company, a wholly owned subsidiary of Humble Oil & Refining Co., operates separately from its larger parent and has its own board of directors.

In recent years these directors have greatly simplified the makeup of their company. And they have applied modern technology to its 9,500-mile system in Texas.

A key man in this huge undertaking is William Scott Spangler, an engineer who went to Texas from Pittsburgh in 1935 and rose through the ranks to the company presidency.

Under Spangler and his predecessor, A. E. Pecore, Humble Pipe Line has turned to automation to reduce its labor costs and to strengthen its competitive position. A reduction in work force has been achieved largely through retirements and normal attrition, and has taken place without sacrificing efficiency on the line. Some pumping operations are now operated entirely by remote control.

Gone are the old slow-speed diesel engines and plunger pumps. High-speed centrifugal pumps, automated control of stations, and applications of other modern technology have kept the company in step with the times.

Career . . . Spangler's decision to enter pipelining at Humble was not an accident.

His uncle, Fred Mellot, was vice president and general superintendent of Humble Pipe Line back in the 1920's, and his grandfather, W. Scott Mellot, was paint superintendent for the company.

But when young Spangler, born and reared in Pittsburgh, went to Longview in 1933 with a fresh diploma in mechanical engineering from Carnegie Tech, he was just one of the work hands. Engineers at that time were lucky to latch onto any kind of job.

However, 2 years later he went to the home office in Houston as a junior engineer and has remained a Houstonian ever since.

His first job was to take an inventory of the company's physical properties. Next he became a trouble shooter, and during World War II he was a "jack of all trades."

During a 9-month spell in 1943, he was loaned to Standard Oil Co. (N. J.), to design fueling stations for the Navy in the Caribbean.

At war's end Spangler was assistant division superintendent for Humble's old southern division (Gulf Coast) and in 1951 became general superintendent for the entire company. He also went on the board that year. In 1957 he advanced to vice president and then to the presidency last April upon Pecore's retirement.

Road ahead . . . Spangler believes the real growth of Humble Pipe Line Co. will come in product pipelining—and probably the greatest expansion will take place outside the boundaries of Texas.

"Right now, all our lines are in Texas," he said. "We are a Texas corporation, but that does not preclude our moving into other states."

He figures future extensions of crude lines into new producing areas probably will mean shorter connections in most instances. The recently constructed Humble natural-gas line from South Texas is a function of the parent company's production department. But product pipelining—that's another matter. That's where the future emphasis will be.

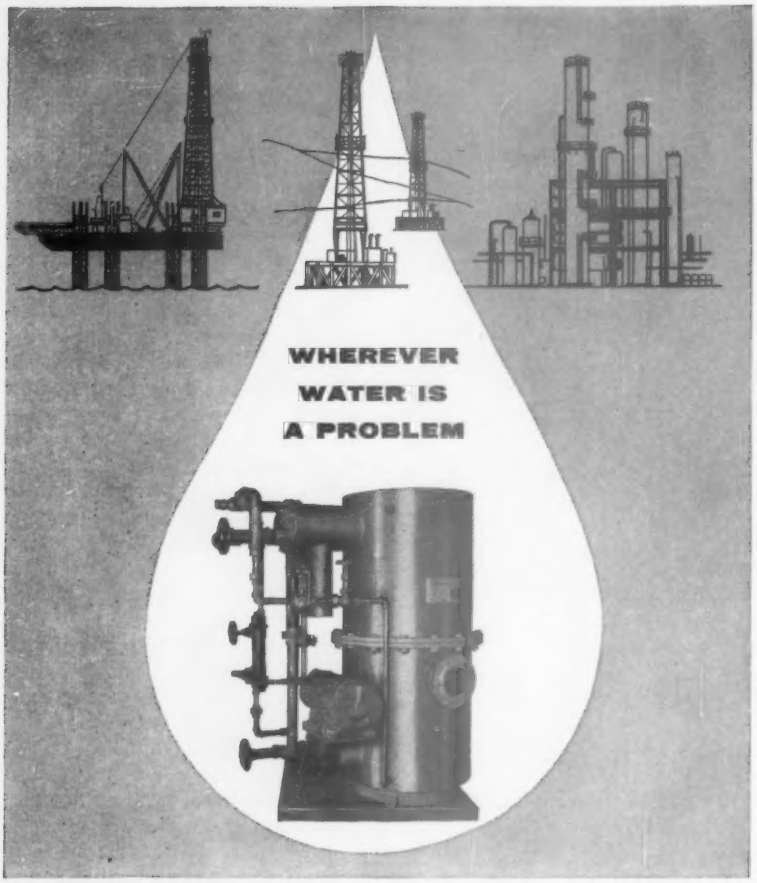
"I foresee tremendous growth in products lines, and we expect to play a big part in it," he says.

●

L. F. McCollum, president of Continental Oil Co., has been elected to the board of trustees of California Institute of Technology.

George W. Roth, assistant manager, direct sales, in Gulf Oil Corp.'s New York district, has been named director of product procurement, refinery sales.

Ronald Ackley, vice president of Exploration Logging, Inc., West Sacramento, Calif., has been named executive vice president. **Charles Lundgren** is operations manager for



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Sold as a complete packaged unit, low in initial cost, inexpensive to maintain, and simple to operate, AMF-Maxim Aquavap evaporators are ideal for use offshore or on land. They convert salt or brackish water to fresh water, using engine jacket water or any other available hot water as a heat source. Thus their operation is fuel free. Five models are available with capacities ranging from 150 gallons per day up to 12,500 gallons per day. The purity of water produced exceeds U. S. Dept. of Health requirements.

Aquavaps are extremely compact. A unit providing, for example, up to 1,000 GPD is less than 4 feet high and laterally takes only about 2 x 4 feet of floor or deck space. Such a unit would weigh approximately 700 lbs. Other types of AMF-Maxim evaporators are available with capacities ranging from 150 to more than 1,000,000 gallons per day. For further information on the Aquavap, write to our Waterford address below.

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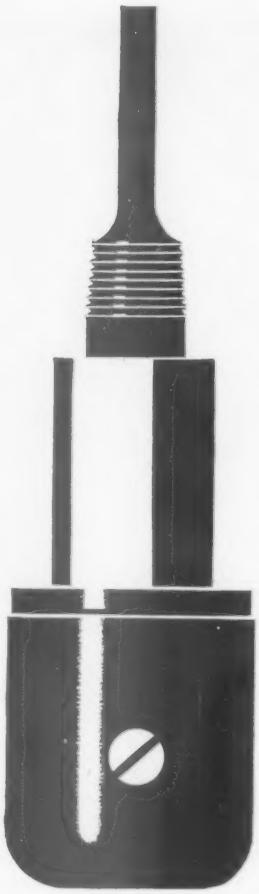

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the Sacramento Valley and **Ronald Hart** is manager of construction, repair, and research.

R. C. Mills, Jr., western division exploration superintendent in Midland, Tex., for Standard Oil Co. of Texas, has been transferred to Houston as assistant manager of nonoperated joint ventures.

Richard W. Fetzner, Sun Oil Co., will receive the AAPG President's award at the association's annual convention in Denver next month. The award recognizes the year's best AAPG bulletin article written by an author under 35 years of age. Honorary membership in AAPG will be granted during the annual meeting to **Fritz L. Aurin,** Southland Royalty Co., Fort Worth; **N. Wood Bass,** Fort Collins, Colo., consultant; **Ralph E. Davis,** Ralph E. Davis Associates, Houston; **Vincent C. Illing,** V. C. Illing & Partners, London; and **Theron Wasson,** Pure Oil Co., Chicago.

W. E. Arthur, manager of business development for Bechtel Corp.'s refinery and chemical division, has been named vice president and managing director of Bechtel Pacific Corp. He will be senior resident officer in the company's new Melbourne, Australia, office.

Dr. George S. Hammond, professor of organic chemistry at California Institute of Technology, will receive American Chemical Society's 1961 award in petroleum chemistry. The award recognizes outstanding research achievements in the field. It will be presented March 27 during the ACS national meeting in St. Louis.

NGAA Elects New Slate of Officers

Max R. Lents, Houston, was elected president of Natural Gasoline Association of America at the group's annual meeting in Dallas last week.

Elected vice presidents were G. W. McCullough, vice president of Phillips Petroleum Co., Bartlesville, Okla.; K. G. Pearce, vice president of Tenneco Oil Co., Houston; Albert Taylor, executive assistant with Amerada Petroleum Corp., Tulsa; and Dr. C. T. Wells, Jr., president of Goliad Corp., Houston.

Lents, vice president and general manager of Reef Corp., and partner in the consulting firm of Miller, Butler & Lents, served as NGAA vice president last year. He succeeds Charles E. Webber, Sun Oil Co., Philadelphia, as president.

Before assuming his present posts, Lents had been vice president and general manager of J. S. Abercrombie Co. and Old Ocean Oil Co. and, earlier, had been with Cotton Valley Operators Committee, one of the country's earliest unitized cycling operations.

Max R. Lents
. . . will head association.

McCullough

Pearce

Taylor

Wells

▶▶▶ Personals

George B. Sewell, geologist with British-American Oil Producing Co. in Amarillo, Tex., has joined Delhi-Taylor Oil Corp. in Denver as geologist.

Alvin J. Raschke, engineer with Felmont Oil Corp. in Seminole, Tex., has joined Rice Engineering & Operating Co. in Hobbs, N. M., as engineer.

R. S. Allen, eastern area construction manager for Bechtel Corp.'s refinery and chemical division in New York, has been transferred to Houston as construction manager for the Gulf Coast region. **Robert S. Cook** will succeed Allen.

Robert F. Warren has been named coordinator of sales for Wilshire Oil Co. of California, and **R. F. Burns** has been promoted to southern California region manager of sales, succeeding Warren. **G. D. Carter** will succeed Burns as district manager in Ontario, Calif. **R. L. Schaeffer** has been named area manager of the Santa Fe Springs, Calif., office, succeeding Carter.

J. F. Hendrickson, Phillips Petroleum Co., Houston, has been elected chairman of American Petroleum Institute's southern district. **Leonard Leon,** Halliburton Co., has been named secretary-treasurer, and **Jack Robbins,** Skinner Corp., has been elected chairman of the district advisory committee. Vice chairmen, and their areas, are **Vic Marsh,** Pan American Petroleum Corp., northeastern Louisiana; **W. N. Kellogg,** Sunray Mid-Continent Oil Co., northwestern Louisiana; **J. W. Russell, Jr.,** Phillips, Arkansas; **H. E. Braunig, Jr.,** Gulf Oil Corp., Mississippi; **Earl Thomas,** Sun Oil Co., southwestern Louisiana; **F. R. Davis,** Phillips, southeastern Louisiana; **A. T. Pall,** Texaco, Southwest Texas; **R. A. Buschman,** Field Drilling Co., Balcones area; **Don Albrecht,** Dowell division of Dow Chemical, Rio Grande Valley. Also, **J. W. Wilson,** Atlantic Refining Co., Texas Gulf Coast; **Gore Kemp,** Davis-Kemp Tool Co., East Texas; and **J. E. Weatherly, Jr.,** Tighe & Weatherly, South Central Texas.

▶▶▶ Personals

Joseph E. Morero, senior vice president of Skelly Oil Co., will be in charge of the company's new exploration department formed by consolidation of the geological and geophysical and land and lease departments. Morero will also be responsible for the production department with

MORERO

SIMPSON

BAILEY

C. L. Blacksher continuing as vice president, production. Within the exploration department, **W. W. Simpson,** manager of the southern and Canadian divisions, has been named manager of land and lease. **W. F. Bailey,** manager of the western division, has been named manager of geology. **W. M. Erdahl** will continue as chief geophysicist. Managers of the three geographical divisions in the exploration department will be **Howard S. Bryant,** northern division; **D. N. Hill,** central division; and **H. L. Spyres,** southern division. **A. L. Cashman,** senior vice president and manager of the land and lease department, will retire June 1, but will continue as a consultant to the company.

Vincent M. Brown has been named assistant secretary-treasurer of National Petroleum Council. He has served with NPC since 1951 as statistician, analyst, and attorney.

R. D. Reedy, senior geologist for Gulf Oil Corp. in Sacramento, Calif., has been promoted to exploration manager of the Casper, Wyo., area. He succeeds **K. R. O'Connell,** who has resigned to become a consulting geologist in Casper.

Max E. Douglas, area geologist for Champlin Oil & Refining Co. in Calgary, has been promoted to West Texas - New Mexico district geologist. He will headquarter in Midland, Tex.

Fred V. Stone, president of Canadian Pacific Oil & Gas, Ltd., has been named a vice chairman of Canadian Pacific Railway Co. He will be in charge CPR's natural resources department.

Paul E. Lopshire, regional engineer for American Oil Co.'s Standard Oil division in Indianapolis, has been transferred to Amoco Australia, Ltd., Brisbane, Australia, subsidiary, as operations and engineering manager.

Frank A. Baron and **Harold M. McNair** have joined Esso Research & Engineering Co.'s analytical-research division as chemists. **Gary L. Harting** has joined the products-research division as chemical engineer and **Donald E. McDowell** has joined products research as petroleum engineer.

R. A. Hamill, chief gauger for Service Pipe Line Co., has been named supervisor of scheduling and measurement, a new position. **K. K. King,** acting chief oil dispatcher, has been named scheduling supervisor, and **R. E. Boyle,** assistant chief gauger, has been named measurement supervisor.

J. P. Exum, engineer in United Gas Pipe Line Co.'s Beaumont, Tex., district pipeline department, has been transferred to Jackson, Miss., as district communications and corrosion supervisor.

W. Douglas Porter, vice president of Mid-Canada Contractors, Ltd., has been elected president of Pipe Line Contractors Association of Canada. He succeeds **G. W. Walker,** Calgary. Other new officers include **W. L. Daniels,** Dutton - Williams Brothers, first vice president; **E. A. Hooper,** Marine Pipeline & Dredging, second vice president; **G. A. Wilkinson,** Marwell Construction Co., secretary; and **A. O. Ackroyd,** Edmonton, executive secretary. Directors are **W. Gant,** H. C. Price of Canada, and **W. A. Rose,** Majestic Contractors.

William B. Bateman has been elected vice president in the petroleum division of Chase Manhattan Bank.

Dr. Richard F. Neblett and **John R. Tuttle, Jr.,** have been named research associates in Esso Research & Engineering Co.'s products-research division.

Warren O. Sparks, production engineer for National Cooperative Refinery Association in Great Bend, Kans., has been promoted to district superintendent in Casper, Wyo.

B. W. Hotten, senior research chemist at California Research Corp.'s Richmond, Calif., laboratory, has been promoted to research associate, greases and industrial lubricants section. **B. A. Fries** has been promoted from group supervisor to research associate in the Richmond petroleum - process development section. **J. L. Dreher,** group supervisor, has been named supervising research chemist, greases and industrial lubricants. **H. E. Knowlton** has been named group supervisor of process correlation in the process-planning section.

Charles Hay, president of Royalite Oil Co., was elected president of Independent Petroleum Association of Canada at the group's first annual meeting. He succeeds **A. G. Bailey,** Bailey Selburn Oil & Gas, who served as provisional president during organization of the group. Other new officers are **Alex Clark,** Calgary & Edmonton Corp., first vice president; **W. S. McGregor,** Consolidated Mic Mac Oils, second vice president; **Charles S. Lee,** Western Decalta Petroleums, third vice president; and **E. A. Galvin,** Medallion Petroleums, secretary-treasurer. Directors elected for a 2-year term include **R. A. Brown, Jr.,** Home Oil Co.; **J. P. Gallagher,** Dome Petroleum; **C. O. Nickle,** Conick Petroleums; and Hay; Clark; McGregor; Galvin; and Bailey. Elected to 1-year terms were **J. F. Hardy,** Central Del Rio Oils; **J. A. McCutchin,** Whitehall Canadian Oils; **A. H. Mitchell,** Mitchell & Associates; **D. E. Mitchell,** Great Plains Development Co. of Canada; **M. M. Newell,** Charter Oil Co.; **G. E. Nielson,** Canadian Husky Oil; and Lee.

Personals

John H. Atwood has been named Gulf Coast manager for Global Marine Exploration Co. with headquarters in Houston. Atwood was supervisor of foreign and domestic drilling operations for Sohio Petroleum Co. before joining Global Marine early this year. He was also chief drilling engineer for Warren-Bradshaw Exploration Co. at one time.

J. Keith Somerville, western division geologist for Felmont Oil Corp. in Midland, Tex., has been named district geologist in Southern Natural Gas Co.'s new Midland office.

W. L. Butte has been named deputy regional coordinator and London Middle East representative for Standard Oil Co. (N. J.). His appointment moves Jersey personnel handling Middle East matters in London into the regional coordinator's organization. Butte's new duties had been handled by **Paul J. Anderson,** who has been nominated as a director of Jersey. Anderson also was senior representative for Jersey in the United Kingdom and Scandinavia. **George M. Parker** succeeded him in this capacity (OGJ, Mar. 13, p. 229). **Robert W. Milbrath,** executive vice president and a director of Esso Export Corp., has been named to succeed Parker as Esso Export president and chairman of the executive committee. In London, **V. C. Georgescu,** associate London Middle East representative, has been named deputy London Middle East representative. **C. M. Boyer,** a member of the New York staff of the Middle East coordinator, has been named assistant London Middle East representative.

Alva H. Stephenson has been appointed chief engineer in Loffland Brothers Co.'s southern division. He will headquarter in New Iberia, La.

R. L. Meadows, superintendent of operations for Movible Offshore Co., Houston, has been elected vice president in charge of operations.

L. J. Tomlinson, district superintendent of production for Continental Oil Co., has been transferred to Seal Beach, Calif., from Ventura, Calif.

Joel M. Wilkinson, geologist for Wellcore Co. in Laurel, Miss., has joined Ingram Oil & Refining Co. in New Orleans as crude-oil purchaser.

K. N. Burns has been named section head in charge of basic geophysical research at Jersey Production Research Co.'s Tulsa research center.

E. B. Krider, National Cooperative Refinery Association, Great Bend, Kans., has been elected chairman of the Great Bend section of AIME's Society of Petroleum Engineers. Other new officers are **J. E. McLeland,** Petroleum, Inc., Great Bend, first vice chairman; **R. L. Waller,** Pan American Petroleum Corp., Ellinwood, second vice chairman; and **C. H. Peterson,** Sunray Mid-Continent Oil Co., Great Bend, secretary - treasurer. Directors include **R. L. Stover,** Anderson-Prichard Oil Corp., Great Bend; **Peter Blanda,** Kewanee Oil Co., Hoisington; and **D. L. Johnson,** Champlin Oil & Refining, Ellinwood.

Charles C. Dunn has been elected managing director of Regent Oil Co., Ltd., United Kingdom affiliate of Texaco Inc. He will headquarter in London. Dunn had been vice president in charge of sales for Texaco Canada, Ltd., since 1951 and a director of that company since 1959.

Ralph James has been promoted to senior staff engineer in the technical division at Humble's Baytown, Tex., refinery.

R. S. Grimes has joined Gulf Research & Development Co.'s production-engineering division as a research engineer.

Jack T. Lindsay, general manager of Lasco Engineering Co., Tulsa, consulting firm, has been named vice president in charge of the petroleum division. The division is responsible for plant and special-product design and development and appraisals.

C. O. MacLeod, Salt Lake City marketing division manager for Continental Oil Co., has been named manager of the new northern division in the Rocky Mountain region. **Dale Chapman,** Denver division manager, will head the new southern division. The two new divisions, both headquartered in Denver, replace three former divisions in Denver, Billings, Mont., and Salt Lake City.

Deaths

Boyd F. Koepke, 63, Tulsa consultant, died March 11 at his home after a heart attack. Koepke was with Universal Oil Products Co. and Aluminum Co. of America before becoming a consultant.

Joseph B. Jenkins, 49, superintendent of Pan American Petroleum Corp.'s Farmington, N. M., producing district, died March 9 in an Abilene, Tex., hospital after several months' illness. Jenkins had been superintendent of the Abilene district since 1953 before being named to the Farmington post January 1. He joined Pan Am in 1935.

George William Hall, 73, Clarion, Pa., drilling contractor, died March 8 in an Oil City, Pa., hospital.

Harold Bahr, 47, engineer with Humble Pipe Line Co., was killed March 12 in a plane crash near Buenos Aires, Argentina. Bahr was supervising pipeline construction for an affiliate in Argentina.

DeVere O. (Ted) Larkin, 63, retired sales engineer for Parkersburg Rig & Reel, died March 14 in a Tulsa hospital after a heart attack. Larkin retired last year.

Emmett Herman Leathers, 86, retired Tulsa driller and producer, died March 8 in a Tulsa hospital. Leathers retired in 1945.

This announcement is neither an offer to sell nor a solicitation of an offer to buy these securities. The offer is made only by the Prospectus.

NEW ISSUE

March 10, 1961

Apco Oil Corporation

$10,072,300

5¾% Subordinated Debentures, Due April 1, 1981

503,615 Shares

Common Stock

($1 Par Value)

The Company is offering to the holders of Class A Stock and Class B Stock of Union Texas Natural Gas Corporation of record at 3:30 P.M. Eastern Standard Time on March 8, 1961, 100,723 Units (each consisting of a $100 Debenture to be issued at par and 5 shares of Common Stock to be issued at $10 per share) pursuant to transferable Subscription Warrants evidencing Rights to purchase one Unit for each 70 shares of Class A Stock and/or Class B Stock of Union Texas Natural Gas Corporation held of record on the record date, all subject to the conditions and on the terms set forth in the Prospectus. The Debentures and the Common Stock will not be separately transferable until March 30, 1962, or such earlier date as the Company may fix. The Subscription Rights expire at 3:30 P.M., Eastern Standard Time, March 23, 1961.

The Underwriters have severally agreed, subject to certain conditions, to purchase from the Company at the Subscription Price, the Units being offered which are not issued upon the exercise of Rights and such Units may be reoffered by the Underwriters.

Subscription Price $150 per Unit

Copies of the Prospectus may be obtained in any State only from such of the several Underwriters, including the undersigned, as may lawfully offer these securities in such State.

Carl M. Loeb, Rhoades & Co. — Smith, Barney & Co.

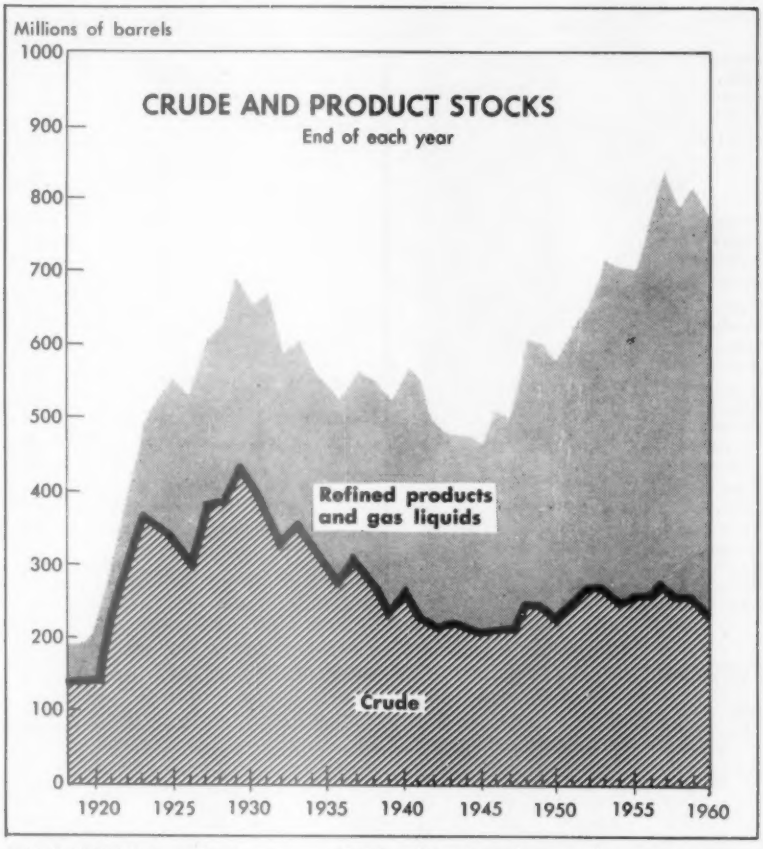
Blyth & Co., Inc. — Eastman Dillon, Union Securities & Co.

Glore, Forgan & Co. — Goldman, Sachs & Co. — Harriman Ripley & Co. Incorporated

Kidder, Peabody & Co. Incorporated — Lazard Frères & Co. — Lehman Brothers

Merrill Lynch, Pierce, Fenner & Smith Incorporated — Stone & Webster Securities Corporation

Wertheim & Co. — White, Weld & Co. Incorporated



CRUDE STOCKS have had a range of 59 million barrels over the past 15 years. Product stocks have varied 315 million barrels in the same period. Back in the early twenties, crude inventory level was three times that of refined products. Crude-stock total now is less than half of reported product inventories.

Change in storage problem can cause refiner headaches

BY JOHN C. CASPER

REFINERS HAVE PROBLEMS. All of these problems are related to the one major requirement for an expanding profitable business. You must have the right product at the right place at the right time.

Even if all of the oil market in this country were controlled by one company, it would call for thorough planning to meet this distribution requirement. But there are thousands of companies and individuals selling petroleum products. Each has supply, distribution, and storage problems.

The surge tank in this production-distribution system is the total volume of raw and finished material carried as inventories. The total includes all grades of crude, light products stripped from the natural-gas stream, and dozens of products made from crude.

For the picture today, we have divided total inventories into two parts—crude and the combination of refined products and gas liquids. There have been some very definite changes in these two groups over the years and the changes tend to create other problems.

Total crude and product stocks reported in the years prior to 1920 showed a mix of about three-fourths crude and one-fourth refined products. By 1925, a full one-third of the total was refined material. But, it was not until 1939 that product stocks topped crude. Stock figures for the chart are end-of-year inventories as reported by the Bureau of Mines.

The buildup of crude in the twenties was a crude-production problem rather than a marketing problem. Crude from many new fields exceeded demands and so went to storage. Much of it was in open-pit storage. Note that total crude stocks started to decline in 1930.

A new trend started about the end of World War II. Sharp gains in demand for petroleum products brought rapid increases in product inventories.

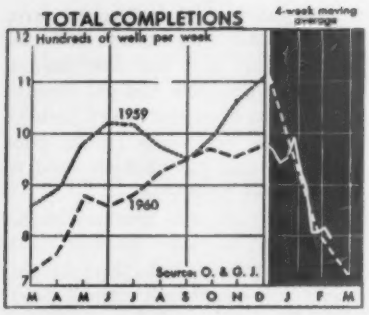
Suppliers are storing more of the available aboveground petroleum in the form of finished products. This often promotes end-of-the-season dumping. Dumping does not solve the industry problem because it does not increase demand for the product. You can't solve a company's oversupply problem by dumping. It will come back to you in the form of deficit-producing price reductions.

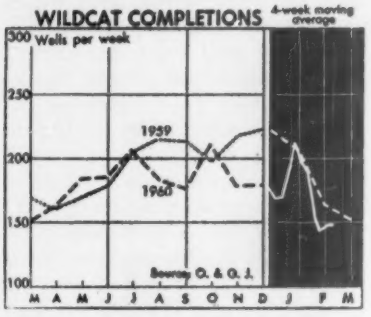
When making plans for the coming season, be sure you can store the products you may not be able to sell.

A quick look at the highlights . . .

	LATEST WEEK	Change from WEEK AGO		Change from YEAR AGO	
Production	7,364,675	UP	113,225	DOWN	287,695
Crude stocks	229,288,000	DOWN	2,164,000	DOWN	23,427,000
Completions	704	DOWN	73	DOWN	4
Refinery runs	8,264,000	DOWN	210,000	UP	482,000
Gasoline stocks	224,653,000	UP	3,561,000	UP	3,528,000
Kerosine stocks	24,896,000	UP	324,000	UP	4,360,000
Distillate stocks	95,888,000	DOWN	703,000	UP	4,712,000
Residual stocks	43,299,000	UP	413,000	UP	72,000
Four-product stocks	388,736,000	UP	3,595,000	UP	12,672,000
Total imports	2,201,400	UP	242,900	UP	435,900

Active Rotary Rigs





	3-13-61	3-6-61	3-14-60
Alabama	5	5	5
Alaska	7	7	(*)
Arkansas	14	12	12
Arizona	0	0	1
California	66	72	80
Land	62	68	79
Offshore	4	4	1
Colorado	24	22	19
Florida	1	1	2
Land	0	0	1
Offshore	1	1	1
Georgia	1	1	0
Illinois	9	17	17
Indiana	2	3	4
Kansas	107	106	107
Kentucky	1	0	4
Louisiana	268	267	287
North	25	22	26
S. Inland waters	106	106	127
S. Land	81	83	81
Offshore	56	56	53
Michigan	11	19	37
Mississippi	48	47	67
Montana	21	17	16
Nebraska	25	26	24
Nevada	0	1	0
New Mexico	83	84	93
North Dakota	21	16	13
Ohio	5	6	3
Oklahoma	182	175	175
Pennsylvania	4	3	6
South Dakota	0	0	1
Texas	610	569	590
S. Inland waters	9	9	8
S. Land	147	149	162
Offshore	3	3	2
North	54	54	39
Panhandle	54	47	48
East	56	50	34
West Central	†162	†146	199
West	125	111	98
Utah	30	28	26
Washington	1	1	0
West Virginia	4	4	5
Wyoming	53	51	57
Total U. S.	**1,603**	1,560	1,651
Cum. avg. to date	1,547	1,541	1,675
Western Canada	190	182	232
Eastern Canada	0	0	3
Grand total	1,793	1,742	1,886

Hughes Tool Co. report. *Data first reported 4-4-60. †Stephens and Eastland counties now included in West Central.

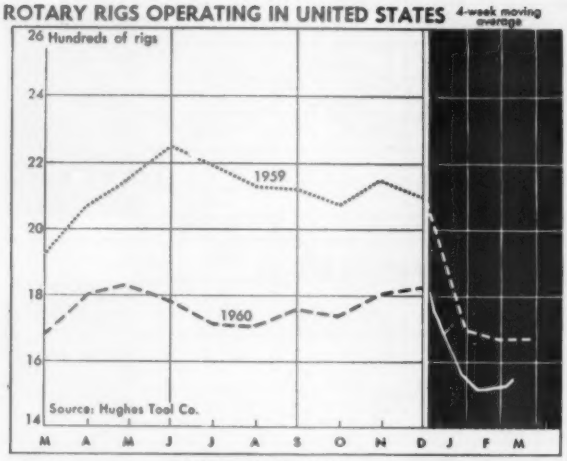
WEEKLY WELL COMPLETIONS . . . WEEK ENDED MARCH 11, 1961

	Total wells							Cum.		Total wildcats					Cum.	
	Total	Crude	Cond.	Gas	Dry	Service	Footage	1961	1960	Total	Crude	Cond.	Gas	Dry	1961	1960
Arkansas	7	6	0	0	1	0	33,186	106	125	1	0	0	0	1	25	33
California	33	22	0	2	9	0	132,527	348	260	5	0	0	1	4	48	59
Colorado	9	1	0	2	6	0	45,001	124	146	4	0	0	1	3	69	69
Illinois	11	7	0	1	3	0	26,772	366	482	3	0	0	1	2	78	126
Indiana	7	3	0	0	4	0	10,325	133	195	3	1	0	0	2	29	79
Kansas	81	36	0	5	20	20	202,425	1,030	683	14	1	0	1	12	197	211
Kentucky	69	25	0	14	29	1	99,507	266	442	10	2	0	2	6	30	50
Louisiana	55	17	0	11	26	1	421,671	649	650	10	0	0	1	9	90	94
North	22	7	0	5	9	1	95,707	244	206	5	0	0	0	5	35	40
South	26	8	0	5	13	0	250,372	320	330	5	0	0	1	4	51	48
Offshore	7	2	0	1	4	0	75,592	85	114	0	0	0	0	0	4	6
Michigan	14	5	0	1	8	0	46,420	153	146	3	0	0	0	3	63	49
Mississippi	7	2	0	0	5	0	82,970	117	153	3	0	0	0	3	42	57
Montana	11	8	0	0	3	0	52,764	83	52	2	0	0	0	2	38	26
Nebraska	9	4	0	0	5	0	36,208	141	150	3	0	0	0	3	63	61
New Mexico	36	20	0	7	9	0	192,980	332	384	9	3	0	0	6	58	56
West	11	3	0	5	3	0	58,511	132	127	2	0	0	0	2	16	11
East	25	17	0	2	6	0	134,469	200	257	7	3	0	0	4	42	45
New York	0	0	0	0	0	0	0	147	72	0	0	0	0	0	2	5
North Dakota	5	2	0	0	3	0	27,124	44	61	2	1	0	0	1	10	10
Ohio	20	6	0	8	3	3	57,736	201	242	2	0	0	1	1	10	12
Oklahoma	73	31	0	12	18	12	302,586	1,090	747	4	2	0	0	2	126	147
Pennsylvania	0	0	0	0	0	0	0	102	67	0	0	0	0	0	7	5
Texas	221	119	13	17	70	2	1,001,968	2,727	3,202	45	6	0	1	38	582	664
Dist. 1	9	4	0	0	5	0	46,213	153	234	4	0	0	0	4	58	85
Dist. 2	7	1	4	1	1	0	51,837	130	128	1	0	0	0	1	29	33
Dist. 3	19	8	1	3	7	0	101,855	206	260	0	0	0	0	0	53	51
Dist. 4	14	7	1	1	5	0	83,914	251	249	2	0	0	0	2	58	74
East	16	10	1	0	5	0	73,088	215	244	2	0	0	0	2	47	50
Dist. 7-B	20	7	0	3	10	0	79,136	367	434	7	1	0	1	5	101	129
West	77	56	0	0	20	1	358,836	693	851	18	4	0	0	14	154	137
Dist. 9	34	17	6	0	10	1	99,296	458	592	8	1	0	0	7	61	88
Dist. 10	25	9	0	9	7	0	107,793	254	210	3	0	0	0	3	21	17
Utah	6	4	0	0	2	0	31,390	48	57	1	0	0	0	1	24	21
West Virginia	15	0	0	12	3	0	32,621	201	174	0	0	0	0	0	0	1
Wyoming	12	4	0	0	8	0	52,531	204	199	4	0	0	0	4	88	78
Miscellaneous*	3	1	0	0	2	0	19,506	71	30	2	0	0	0	2	54	16
Total U. S.	**704**	323	13	92	237	39	2,908,218	8,683	8,719	**130**	16	0	9	105	1,733	1,929
Total prev. week	777	340	14	62	310	51	3,176,946	.....	.....	183	11	3	7	162	.....	.....
Cumulative 1961	8,683	3,935	208	845	3,141	554	35,161,750	.....	.....	1,733	148	23	75	1,487	.....	.....
Cumulative 1960	8,719	4,064	283	770	3,333	269	37,775,899	.....	.....	1,929	177	19	58	1,675	.....	.....
Western Canada	45	18	0	9	17	1	261,335	481	484	21	3	0	3	15	158	141

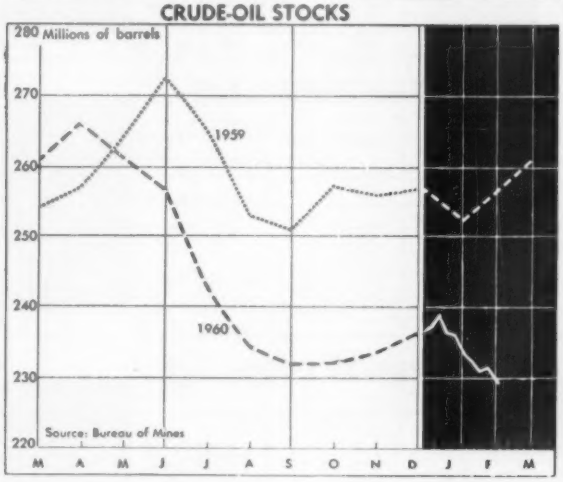
*Wash., Ala., Mo.

PRODUCTION

ROTARY RIGS OPERATING IN UNITED STATES



CRUDE-OIL STOCKS



CRUDE-OIL STOCKS BY STATES OF ORIGIN*

(Thousands of barrels)

	3-4-61	2-25-61	3-5-60
Pennsylvania Grade	2,160	2,154	2,212
Other Appalachian	1,231	1,312	1,985
Illinois, Indiana, Michigan	9,055	9,157	9,607
Nebraska and North Dakota	3,018	2,971	2,615
Kansas	9,068	8,951	9,075
Oklahoma	14,678	15,251	16,855
Arkansas	1,657	1,661	2,101
Louisiana	17,873	17,984	19,556
North	3,323	3,315	3,086
South	14,550	14,669	16,470
Mississippi, Alabama, Florida	2,212	2,117	2,889
New Mexico	7,425	7,322	7,628
Texas	96,069	96,874	107,215
East Texas	8,447	8,398	7,890
West Texas	43,660	44,325	49,767
Texas Gulf	16,042	16,353	18,105
Other Texas	27,920	27,798	31,453
Wyoming	16,927	16,875	17,382
Other Rocky Mountain	9,429	9,452	9,324
California	24,629	24,619	29,510
Foreign	†13,857	14,752	14,761
Total	**229,288**	231,452	252,715

*Bureau of Mines. †Includes 4,247,000 bbl. in California.

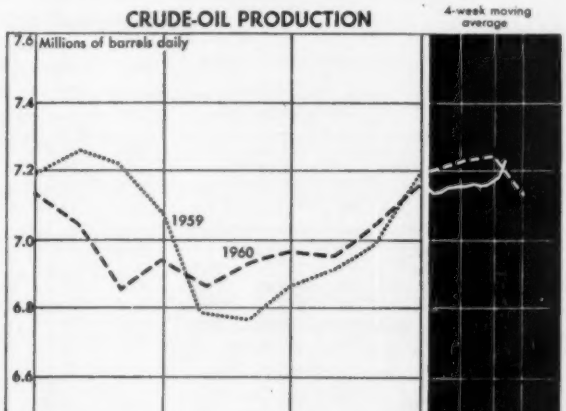
DAILY AVERAGE PRODUCTION FOR WEEK

	March 11, 1961 — Crude oil	Lease condensate	Total	Mar. 4 total
Alabama	20,125	.....	20,125	21,075
Alaska	9,000	.....	9,000	8,800
Arkansas	75,590	110	75,700	78,325
California	827,600	.....	827,600	823,800
Colorado	131,800	.....	131,800	132,100
Eastern	40,300	.....	40,300	39,500
Florida	1,025	.....	1,025	1,000
Illinois	208,400	.....	208,400	212,700
Indiana	31,800	.....	31,800	31,700
Kansas	†315,850	.....	†315,850	†313,850
Kentucky	56,300	.....	56,300	56,400
Louisiana	1,000,200	156,000	1,156,200	1,151,400
North	104,200	6,000	110,200	111,700
South	896,000	150,000	1,046,000	1,039,700
Michigan	51,100	.....	51,100	50,200
Mississippi	146,450	4,525	150,975	150,975
Montana	81,600	.....	81,600	82,000
Nebraska	67,200	.....	67,200	66,900
Nevada	400	.....	400	300
New Mexico	299,000	8,500	307,500	303,225
North Dakota	68,100	.....	68,100	71,200
Oklahoma	†523,000	.....	†523,000	†509,000
Texas	2,658,000	100,150	2,758,150	2,667,850
Dist. 1	44,000	3,700	47,700	46,550
Dist. 2	117,000	8,800	125,800	118,375
Dist. 3	326,000	42,000	368,000	362,850
Dist. 4	192,000	14,000	206,000	197,425
Dist. 5	29,000	500	29,500	28,350
Dist. 6	123,000	9,000	132,000	126,300
East Texas field	142,000	.....	142,000	136,300
Dist. 7-B	134,000	500	134,500	131,075
Dist. 7-C	123,000	3,850	126,850	121,125
Dist. 8	1,130,000	12,000	1,142,000	1,100,275
Dist. 9	192,000	3,800	195,800	194,075
Dist. 10	106,000	2,000	108,000	105,150
Utah	98,400	.....	98,400	93,500
Wyoming	383,400	.....	383,400	385,100
Others	‡750	.....	‡750	‡550
Total U. S.	7,095,390	269,285	**7,364,675**	7,251,450
Change frov prev. week, up			**113,225**	
Canada	†532,900	.....	†532,900	†602,200

Total U. S. prod., January 1-March 11 ..... 503,432,900 bbl.
Same period last year (crude plus cond.) ..... *505,103,900 bbl.

*Includes 15,961,300 bbl. condensate. †Week ended previous Monday. ‡South Dakota and Arizona.

CRUDE-OIL PRODUCTION



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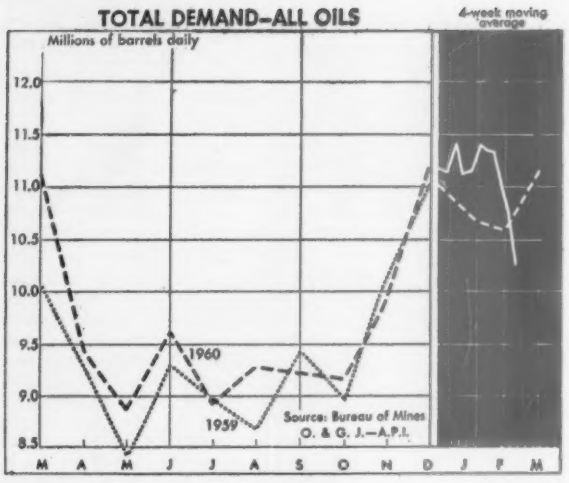

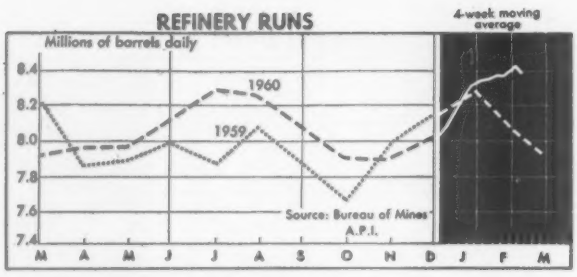

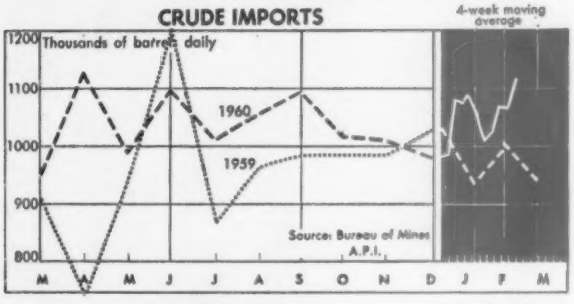

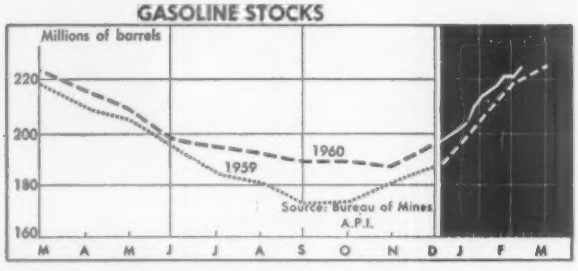

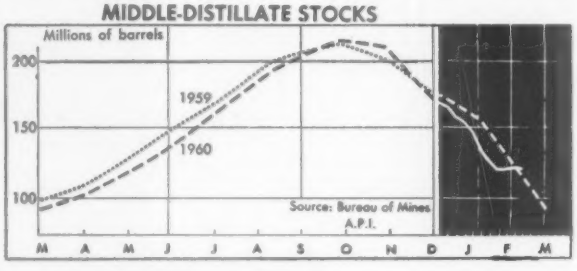

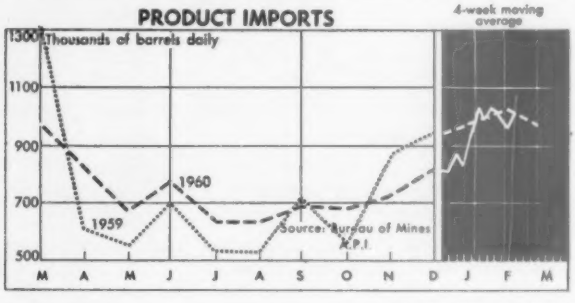

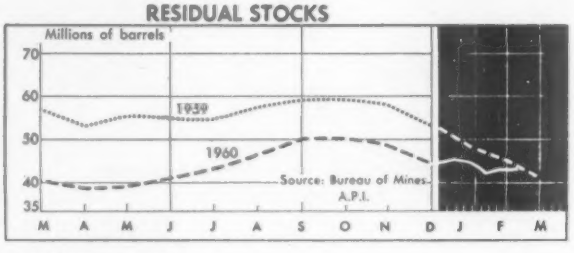

API REFINERY REPORT—MARCH 10, 1961

(Thousands of Barrels)

District—	Daily avg. runs	Daily average production Gaso.*	Kero.	Dist.	Resid.	Stocks‡ Gaso.†	Kero.	Dist.	Resid.	Bureau of Mines, March 1960 Daily avg. runs	Daily average production Gaso.*	Kero.	Dist.	Resid.
East Coast	1,131	461.1	41.9	336.0	159.0	48,764	9,964	32,780	12,710	1,111	525.4	34.1	343.9	170.7
Appalachian:														
Dist. 1	100	42.0	5.9	22.9	13.0	6,233	718	2,378	557	100	39.1	4.4	21.4	12.7
Dist. 2	96	44.7	7.1	17.3	14.3	3,145	378	988	378	102	43.6	8.8	15.8	17.1
Ind., Ill., Ky.	1,544	809.6	83.9	315.0	166.4	40,314	4,411	16,194	5,423	1,468	734.5	77.3	316.9	210.0
Minn., Wis., Dak.	129	63.7	4.1	29.9	17.4	6,902	657	4,688	626	116	55.5	5.8	26.5	19.8
Okla., Kans., Mo.	693	387.3	19.7	169.1	17.6	21,537	1,093	8,833	867	685	380.2	13.0	170.9	43.5
Inland Texas	299	219.4	9.1	47.6	18.1	8,460	474	1,429	2,473	286	211.6	8.9	51.8	19.2
Texas Gulf Coast	2,042	979.9	170.3	495.4	142.1	33,063	2,802	6,986	5,218	1,864	940.9	124.1	418.3	136.5
La. Gulf Coast	718	369.9	88.8	148.4	51.3	11,714	1,789	3,723	1,334	645	358.7	52.1	142.3	44.2
N. La. and Ark.	107	69.6	6.3	22.8	6.1	6,446	635	2,058	170	100	65.8	4.0	21.8	7.1
Rocky Mountain:														
New Mexico	25	12.1	0.7	6.3	2.4	933	41	139	81	25	112.5	0.5	4.1	2.8
Other Rocky Mt.	265	123.3	6.6	59.0	29.9	7,770	367	2,240	1,008	280	130.1	3.4	64.4	33.7
West Coast	1,115	493.7	40.0	171.0	228.1	29,372	1,567	13,452	12,454	1,135	539.6	29.9	198.4	284.8
Mar. 10, 1961	8,264	4,076.3	484.4	1,840.7	865.7	224,653	24,896	95,888	43,299	7,917	4,037.5	366.3	1,796.5	1,002.1
Mar. 3, 1961	8,474	4,039.0	464.3	2,074.7	981.6	221,092	24,572	96,591	42,886	.....	.....	.....	.....	.....
Mar. 11, 1960	7,782	3,948.9	353.7	1,735.6	1,068.1	221,125	20,536	91,176	43,227	.....	.....	.....	.....	.....

*At refineries including natural blended. †Finished and unfinished. ‡At refineries, bulk terminals, in transit, and in pipelines.

CRUDE-OIL PRICES

GRAVITY SCHEDULE

	Signal Hill, Calif.	Oklahoma	West Tex. (sour)	West Tex. (Inter.)	No.* Texas	Texas Refugio Light	Bayou Sale (La.)	Denver Jules-burg	Wyo. (sour)
14-14.9	$1.86	....	....	....	....	....	....	....	....
15-15.9	1.93	....	....	....	....	....	....	....	1.81
16-16.9	2.00	....	....	....	....	....	....	....	1.86
17-17.9	2.06	....	....	....	....	....	....	....	1.96
18-18.9	2.13	....	....	....	....	....	....	....	1.96
19-19.9	2.20	....	....	....	....	....	....	....	2.01
20-20.9	2.27	$2.49	$2.35	$2.61	$2.29	$2.95	$2.90	$2.58	2.06
21-21.9	2.33	2.52	2.38	2.63	2.33	2.97	2.92	2.60	2.11
22-22.9	2.40	2.55	2.41	2.65	2.37	2.99	2.94	2.62	2.16
23-23.9	2.46	2.58	2.44	2.67	2.41	3.01	2.96	2.64	2.21
24-24.9	2.53	2.61	2.47	2.69	2.45	3.03	2.98	2.66	2.26
25-25.9	2.60	2.64	2.50	2.71	2.49	3.05	3.00	2.68	2.31
26-26.9	2.67	2.67	2.53	2.73	2.53	3.07	3.02	2.70	2.36
27-27.9	2.74	2.70	2.56	2.75	2.57	3.09	3.04	2.72	2.49
28-28.9	2.81	2.73	2.59	2.77	2.61	3.11	3.06	2.74	2.54
29-29.9	2.87	2.76	2.62	2.79	2.65	3.13	3.08	2.76	2.59
30-30.9	2.93	2.79	2.65	2.81	2.69	3.15	3.10	2.78	2.63
31-31.9	3.00	2.82	2.68	2.83	2.73	3.17	3.12	2.80	2.67
32-32.9	3.06	2.85	2.71	2.85	2.77	3.19	3.14	2.82	2.71
33-33.9	3.12	2.88	2.74	2.87	2.81	3.21	3.16	2.84	2.75
34-34.9	3.17	2.91	2.77	2.89	2.85	3.23	3.18	2.86	2.79
35-35.9	3.22	2.94	2.80	2.91	2.89	3.25	3.20	2.88	2.83
36-36.9	3.27	2.97	2.83	2.93	2.93	3.27	3.22	2.90	2.87
37-37.9	3.31	2.99	2.86	2.95	2.95	3.29	3.24	2.92	2.89
38-38.9	....	3.01	2.89	2.97	2.97	3.31	3.26	2.94	2.91
39-39.9	....	3.03	2.92	2.99	2.99	3.33	3.28	2.96	2.93
40-44.9	....	3.05	2.95	3.01	3.01	3.35	3.30	2.98	2.95

*Cooke, Grayson, Montague.

FLAT PRICES

Louisiana:	
Sweet Lake	$3.00
Texas:	
East Texas	3.05-3.25
Conroe	3.23-3.53
Van	3.08
Pennsylvania Grade:	
Bradford	$4.75-4.80
Middle District	4.52
Southwest Pennsylvania	4.25
West Virginia	4.17
Buckeye Grade	4.08
Illinois Basin	3.00-3.05

FOREIGN

Middle East, Persian Gulf: (cargoes f.o.b. lifting port)	
Arabian, 34.0°-34.9°, Ras Tanura	$1.80
Iranian, 34.0°-34.9°, Bandar Mashur	1.78
Iranian, 34.0°-34.9°, Abadan	1.73
Iraq, 35.0°-35.9°, Fao	1.72
Kuwait, 31.0°-31.9°, Mina-al-Ahmadi	1.59
Qatar, 41.0°-41.9°, Umm Said	1.95
Middle East, E. Mediterranean:	
Arabian, 34.0°-34.9°, Sidon	$2.17
Iraq, Mosul-Kirkuk, 35.0°-35.9°, Tripoli	2.19
Far East (cargoes, f.o.b. Lutong, Sarawak):	
Seria Light, 36°	2.42
Canada:	
Leduc-Woodbend	$2.53
Redwater (Alta.)	2.42
Weyburn (light)	2.06
Midale C	1.70
Venezuela:	
Cumbarebo, 47°-47.9°, Tucupido	3.34
San Joaquin, 40°-40.9°, Puerto La Cruz	3.08
Oficina, 35°-35.9°, Puerto La Cruz	2.80
Tia Juana medium, 26°-26.9°, Amuay*	2.30
Quiriquire, 16.0-16.4°, Caripito	2.10
Lagunillas heavy, flat, Las Piedras*	2.10
Bachaquero, flat, 15°-16°, Las Piedras*	1.88

Prices for all crudes of 24° or lighter vary 2 cents per degree change, up or down. All crudes heavier than 24° vary 2.5 cents per half-degree gravity change.

*Also available at La Salina at 3 cents per barrel less.

TANKER RATES (Long Ton)

(Latest reported spot fixtures)

★ Gulf-NY, dirty (ATRS—20%)	$2.28
Carib.-NY, dirty (ATRS—60%)	1.10
★ Carib.-UK, dirty (Scale—57.5%) (13s. 10d.)	1.93
★ PG-Japan, dirty (USMC—65%)	3.57
PG-UK, dirty (Scale—50%) (30s. 2d.)	4.23

★Denotes change previous week.

REFINED PRODUCTS

Following quotations are realistic spot prices for refined products moving interstate on Wednesday each week. They may differ from refiners' posted prices and should not be considered as postings.

Light-product prices are in cents per gallon. Residual and crude prices are dollars per barrel. Crude prices are at the well unless otherwise listed.

GASOLINE*

Mid-Continent (Group 3):	
Regular (91 octane)	12.00-12.25
Premium (99 octane)	14.75-15.00
Natural gasoline (26-70)	4.5
Breckenridge	4.0
Gulf Coast (cargoes for coastwise or export movements):	
Regular (90 octane)	11.00
Regular (92 octane)	11.25
Premium (98 octane)	12.25
California (rack) Los Angeles:	
★ Regular (90 octane)	11.00
★ Premium (94 octane)	12.00
★ Premium (100 octane)	13.50
Caribbean area (cargoes):	
Regular (87 octane)	9.50
Premium (97 octane)	11.625

*Quotations are for octanes shown. Prices usually vary with octane ratings within the regular, premium, and aviation grades.

KEROSINE AND DISTILLATE

Mid-Continent (Group 3):	
Kerosine 42-44	10.625-10.75
Diesel oil (58 d.i. and above)	10.25
Distillate No. 1	10.25
Distillate No. 2	9.25
Gulf Coast (cargoes):	
Kerosine 41-43	10.25
Distillate No. 2	9.50
New York Harbor (barges):	
Kerosine 42-43	11.90
Distillate No. 2	10.90
Diesel fuel, 48-52 d.i.	11.05
Caribbean area (cargoes):	
Distillate No. 2	8.625

RESIDUAL FUEL (Bbl.)

Mid-Continent (Group 3):	
Residual fuel (max 1% S)	$1.90
Gulf Coast (cargoes):	
Bunker C fuel	2.30
New York Harbor (barges):	
Bunker C fuel	2.52
Caribbean (cargoes):	
Bunker C	2.00
California (rack):	
Bunker C fuel, Los Angeles	2.25

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FOR SALE: Surplus equipment, new and used. Pumps, electric motors, switches, and transformers. Write for descriptive list and prices. East Texas Salt Water Disposal Company, Box 633, Kilgore, Texas.

FOR SALE: 28 L Drilling Machine, Complete with Steel Dog house and floor. Tool house. All 6¼" and 8" tools, Lighting plant and Butane tank. Price: $10,000.00. F.O.B. at Nowata, Oklahoma. Inquire at: N.Y.K. Oil Co. Phone 437, Nowata, Okla.

FOR SALE: 1—24" x 75' De-Ethanizer Column with Accumulator: 1—36" x 49' De-Butanizer Column w/Condensor, Accumulator and Re-Boiler; 1—30" x 54' De-Propanizer Column with Reboiler, Condensor, Reflux Accumulator and Two Propane Dryers. Cities Service Petroleum Company, Att: T. P. Mace, Box 4577—Oklahoma City 9, Oklahoma.

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FOR SALE OR TRADE

7¼" by 14" Gardner Denver Mud Pump, completely gone through, will trade for casing or tubing.

Contact Luke Wise
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28 KW generator set, skid mounted with Hercules 6-cylinder Model WXL-C-3 engine, electric machinery .87F 1,200 RPM, 3-phase, 60-cycle, 440-volt generator, belt driven DC exciter, and with small transformer for 110-volt lights. Unit has sheet steel housing and removable side doors, volt, amp, and frequency meters with rheostat.

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9 MM BTU/hr.	Carbon Tubes	
7.5 MM BTU/hr.	CHROME Tubes	(2)
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2.5 MM BTU/hr.	Carbon Tubes	
2 MM BTU/hr.	Carbon Tubes	

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Box M-300, The Oil and Gas Journal
Tulsa, Oklahoma

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To develop new macro and micro methods of analysis, for modification of existing methods, and for trouble-shooting analysis in chemical and petroleum field.

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P. O. Box 956 Tyler, Texas Phone LYric 3-6411

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Refinery Division

KERR-McGEE BLDG.

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LANDMAN—25 years experience with major and independent in all phases of Land, Exploration and Administration. Box M-311, The Oil and Gas Journal, Tulsa, Oklahoma.

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ADMINISTRATIVE ENGINEER: 12 years responsible experience in project engineering, design, processing operations, maintenance scheduling at supervisory capacities for major oil refining company. Age 38, family, B. S. in Chemical Engineering. Resume available. Box 31 Q 160, The Oil and Gas Journal, 4041 Marlton Ave., Los Angeles 8, Calif.

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LEASE AND DRILLING BLOCKS

3 CALIF. LEASE BLOCKS, 35,000 Acres Govt. Central California; 8,000 Acres Fee leases Central California 1,100 Acres Newhall, offset production. Cecil Blinn, 5160 N. Harrison, Fresno, California. BAldwin 7-0777.

5,000 ACRE RECTANGLE N.E. Kentucky. Within brown area, Page 54, May 30, 1960, The Oil and Gas Journal. Box 446, Charleston 22, W. Virginia.

WANT TO PURCHASE Gas and Oil Properties—Submit Reserve Estimates, Income, etc. Box M-210, The Oil and Gas Journal, Tulsa, Oklahoma.

OIL LEASE CRANE County, Texas: Available S/239 acres, Section 18, Block B-28, PSL, two miles from new gas discovery Section 23, Blk. 4, H&TC, Hill & Meeker well. Quick action, address landowner: Jefferson G. Smith, 715 Littlefield Building, Austin 18, Texas.

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Box M-318, The Oil and Gas Journal
Tulsa, Oklahoma

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OWING TO DIFFERING views of parnership policy, I believe I can secure at good bargain, for acceptable purchaser, our Whitehouse Co. 12,000 acres, good structural conditions, pipeline intersecting, price 20 cents per thousand, 2 gas wells (located by myself); 4 unfractured oil sands each seemingly quite potential for fracturing. All less than 1,700 ft. Probably at least 2 more even better before reaching 3,100 ft. Of the 5 Gas Fields located to date in North Ala., I located 4. Hence, feel qualified to advise. S. A. Hobson, Geologist, Haleyville, Ala.

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U. S. DEPARTMENT OF THE INTERIOR, Bureau of Land Management, Washington 25, D. C. Notice is hereby given that approximately 321.89 acres of land in two parcels, 79.99 acres within the undefined known geologic structure of the Pine Island field and 241.90 acres within the known geologic structure of the Greenwood-Waskom field, in Caddo Parish, Louisiana, will offered for competitive oil and gas leasing through sealed bids to the qualified bidder of the highest cash amount per acre at 1:00 P.M., E.S.T. April 5, 1961, when bids will be opened. Full details of the lease offering, and how and where to submit bids, may be obtained from the Manager, Eastern States Land Office, Bureau of Land Management, Washington 25, D.C. H.K. Scholl, Manager.

LEGAL

U. S. DEPARTMENT OF THE INTERIOR, Bureau of Land Management, Washington 25, D. C. Notice is hereby given that approximately 120 acres of land in one parcel within the known geologic structure of the Tar Creek field, Wilkinson County, Mississippi, will be offered for competitive oil and gas leasing through sealed bids to the qualified bidder of the highest cash amount per acre at 1:00 P.M., E.S.T. April 12, 1961, when bids will be opened. Full details of the lease offering, and how and where to submit bids, may be obtained from the Manager, Eastern States Land Office, Bureau of Land Management, Washington 25, D. C. H. K. Scholl, Manager.

LEGAL

U. S. DEPARTMENT OF THE INTERIOR, Bureau of Land Management, Land Office, Cheyenne, Wyoming. Notice is hereby given that 5,328.38 acres of land in 49 parcels within the known geologic structures of a number of fields in Big Horn, Campbell, Fremont, Natrona and Washakie Counties, Wyoming, are offered for competitive oil and gas leasing through sealed bids to the qualified bidder of the highest cash amount per acre at 2:00 P.M., MST, May 3, 1961, when bids will be opened. Full details of the offering, and how and where to submit bids, may be obtained from the Land Office, Cheyenne, Wyoming. Arvin H. Olswold, Chief, Minerals Section.

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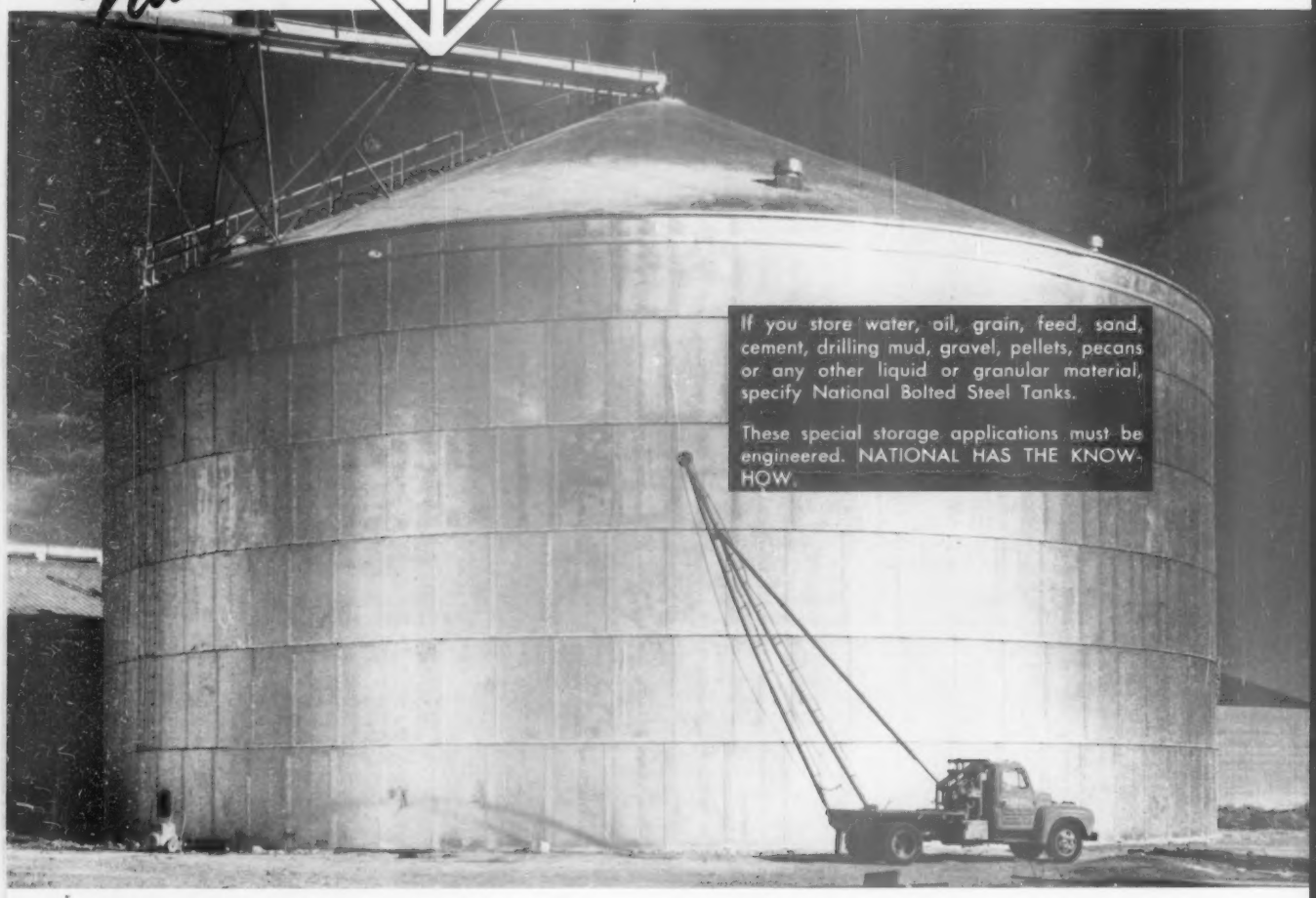
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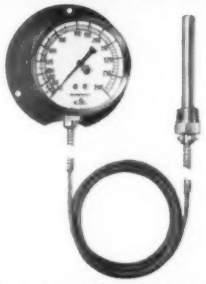

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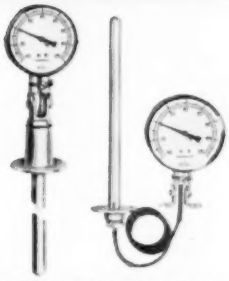

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